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# The manufacture of orange squash in developing countries

CFTRI, Experiment Station
Gole Bungalow, Chhindwara Road
Nagpur-1.

Tropical Products Institute Report

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Penelope A. Mars

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## The Manufacture of Orange Squash in Developing Countries

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## Part I

## The Cost Structure

CFTRI, Experiment Station
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Nagpur-I.

### 1 The Scope and Purpose of the Report

General

This report is one of a series, designed with the purpose both of serving local entrepreneurs and economic planning organisations in developing countries as a basis for making decisions or, if external help is necessary, as a blueprint for feasibility surveys to be carried out by economists from the Tropical Products Institute.

The main emphasis in the report is on a series of real (physical) cost models giving the inputs of factory floorspace, labour, machinery services and materials required for a range of small to medium outputs, depending on certain labour intensive combinations of labour and capital, which are assumed to produce at typical levels of efficiency. Given this information, anyone who has assessed the market for a certain product, which was previously imported into a developing country, can then proceed to find out what it would cost to produce that output at local factor costs. The next step in making an investment decision is to ask whether, given the market, the enterprise would be profitable either immediately or in the near future.

Alternatively, in the case of products which are not imported or already manufactured and are unknown in the area, the models would facilitate the estimation of a local price for the purpose of test-marketing the product.

Although prominence is given in the reports to costs in real or physical terms, which can be used as a basis for computing money costs in any country and at any time (provided that the technique does not become obsolete), a full costing has also been carried out in terms of the factor costs prevailing in a West African country in mid-1967*. This gives the reader a rough idea of the cost and possible profit per unit at different levels of output, which may make possible a preliminary decision as to the most appropriate scale for the existing market. In addition, this part of the report explores the concept of economies of scale.

The report includes a description of the methods of processing, sufficiently detailed to make the physical costing information comprehensible, and flexible, and also to indicate the main technical and operational difficulties, since the entrepreneur must assess his capacity to resolve them in local conditions. The report is not intended to serve as a production handbook, but as an aid to economic decision making. Normally the successful launching of a new undertaking requires expert technical supervision on the spot, which may have to be maintained over a long period.

Products of the orange

The physical composition of the orange, which is an aid to understanding the various products associated with orange juice and is also relevant to later sections of the report, is given below:(1)

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* A method of bringing the prices of imported items, such as machinery, up to date is given on pages 36-37.

| Component<br>Juice | Per centage<br>by weight |
|---|---|
| Juice | 40 - 45 |
| Flavedo (outer peel) | 8 - 10 |
| Albedo (inner peel) | 15 - 30 |
| Rag and pulp | 20 - 30 |
| Seeds | 0 - 4 |

Juice products. Single strength juice, from which orange squash may be made, is now produced largely for direct consumption and is packed after preservation in cans or bottles. Juice intended for further processing is generally concentrated, the two main processes used being by vacuum or freezing. As far as the soft drinks industry is concerned concentrates, may be used directly as a raw material, or they may be converted into 'compounds' which contain extra colour and flavouring materials. Compounds are purchased by the soft drinks trade for simple manufacture of soft drinks. (Very little freeze-dried concentrate is used for squashes.)

Peel products. The main products based on orange peel are animal feeds, pectins and essential oils. Peel may also be used to make pectin, candied at the factory or preserved in brine and exported as material for candied peel or marmalade, although normally marmalade requires orange pulp as well as peel. These products are of minor importance.

Peel is being used to an increasing extent in "comminuted" (or finely ground) form in "whole orange drinks", for dilution on direct consumption and in "comminuted bases" which are sold as intermediate materials for the whole orange drinks. These drinks also contain juice and possibly a proportion of other solid parts of the orange.(2)

The relative importance of some of these products is discussed in a later section.

The Choice of Orange Squash

Squashes have been defined as consisting, "in the main, of varied mixtures of citrus juices with fine cane sugar or cane sugar syrups, and with additional flavouring ingredients such as citric acid, essential oils or essences, colouring matter, etc."(3) Beet sugar may be used, and preservatives are usually added.

The manufacture of orange squash was considered to be a suitable subject for a report of this nature for several reasons. In the first place, the geographical distribution of oranges is wide and output appears to have increased at a high rate.

Annual average production of oranges and tangerines in developed countries is estimated to have increased from 8.9 million tons in 1953-55 to 10.1 million tons in 1962-64, an increase of 13 per cent. The corresponding figures for developing countries are 5.1 million tons in 1953-55 and 7.7 million tons in 1962-64, an increase of 50 per cent. There is said to be over-production of fresh citrus fruit, while the demand for prepared foods is increasing, owing to changing standards and ways of living.(4) Orange growers in developing countries are thus seeking outlets for their product other than the fresh fruit market.

Industries which can be viable on a small scale are suitable for developing countries owing to the prevailing shortage of capital and entrepreneurial skill.

In a study of small scale industries suitable for developing countries, the authors place bottled and canned soft drinks in the category of products with local markets and high transfer costs, on which they comment as follows:

> "Product transfer costs ........... tend to exceed transfer costs of the material inputs, favoring plant location near the consuming markets. Transfer costs of the finished products are high in relation to potential scale economies as well. The production process accounts for a moderate to substantial share of total costs but involves relatively simple mixing, assembly, or physical operations offering only low or moderate advantage to large-scale production. Incentive to gain this moderate advantage by serving several markets from a central plant is inhibited, in greater or less degree, by the cost of product transfer."(5)

The findings of this report do not substantiate the assertion that transfer costs of the finished product are high in relation to economies of scale, in so far as domestic production and local transport costs are concerned. However, it is very true with regard to transport costs on imported squash, and the production of orange squash seems to be eligible for inclusion in programmes for import substitution.

Many other tropical fruits can be used for making squash (see page 5). However, orange squash is said to be the most popular.

It is probable that it is the marketing attributes of orange squash production which most favour its establishment in developing countries. The climate in hot countries stimulates consumption of beverages and squash has the advantage that it can be retailed in very small quantities, i.e., by the glass which can be cheap enough to sell to people with very low incomes. When sold for household consumption it has the advantages that it is inevitably packaged in a container suitable for storage even in households which do not contain such rudimentary storage equipment as shelves, and will keep for a reasonable time without refrigeration.

Other Relevant Aspects of Orange Processing Industries

The manufacture of orange squash from locally grown oranges actually plays a minor role in the complex of orange processing industries, whose products have been listed on page 2.

The importance of various forms of citrus juice in international trade is illustrated by the fact that in 1964 citrus juice imports into the United Kingdom reached a level of some 200,000 tons of fresh fruit, compared with actual fresh citrus fruit imports of 500,000 tons(6). It was consequently decided at an early stage that the importance of orange juice as an export product might justify the preparation of a further report, defining the equipment and other requirements for producing concentrated orange juice on a small scale. This report would also deal in less detail with the production of natural strength juice, frozen concentrated juice and concentrated comminuted orange.

A short questionnaire was sent to a number of tropical orange producing countries in order to obtain some direct information about the structure of their orange processing industries and the typical scale of juice production. An important fact which emerged was that in certain orange producing areas, namely Brazil, Bolivia and the East Caribbean, popular orange beverages are made not from juice extracted in the same factory but from ingredients based on oranges which might be manufactured in other countries and imported.

This disclosure led to the decision to investigate in the main report the economics of orange squash industries based on imported orange compound.

The subject of the "comminuted citrus drink", defined in the British Soft Drinks Regulations as "a soft drink produced by a process involving the comminution (pulverisation) of the entire citrus fruit", has not been dealt with fully in this report.[7] These drinks which may, like squash, require dilution or appear in a ready-to-drink form first appeared on the British market in 1953. By 1965, the output in Britain of comminuted drinks for dilution exceeded that of squashes and cordials.

While the advantage of comminuted citrus drinks over squash from the consumer's point of view appears to lie in the "peely" flavour, resulting from the inclusion of peel as well as juice, their economic advantage from the producer's point of view seems to be due to the peel flavour making unnecessary the addition of other fruit flavouring materials,[8] and to the fact that a larger amount of "drink" for dilution can evidently be derived from a given amount of oranges. According to the British Soft Drinks Regulations 1964, a comminuted citrus drink for consumption after dilution shall contain 10 lb. potable citrus fruit content per 10 gallons while a citrus squash must contain 25 per cent citrus fruit juice by volume.[9] An additional advantage of comminuted drinks is that no preservative such as sulphur dioxide ($SO_2$) is necessary.

Some information would be given in the proposed report on orange juice processing, on the manufacture of a comminuted "base" for export or utilisation by independent beverage manufacturers in the citrus growing area. The comminuted base may be used for making a "whole fruit" beverage for dilution by methods similar to those used for making orange squash from compound. Whole fruit beverages may also be made directly from oranges by a small scale comminution process.

Outline of the Report

The remaining chapters of Part I of the report deal with the manufacture of orange squash from oranges or imported "compound" at four different levels of output. The choice of the assumption upon which the models are based is explained first, and then, because comparisons can only be made in monetary terms, the results of the costings at local prices in a West African country are discussed. The method of production is then described.

Part II of the report covers the sources of information and methods of calculation used in the tables, which are dealt with in numerical order. Appendix I gives some additional information which might be required in carrying out feasibility surveys. Appendix II gives a list of persons, firms and institutions who, in addition to colleagues at the Tropical Products Institute, kindly supplied information for the report.

2 The Design of the Models

Tables 4 to 7 give quantities and cost of equipment and stores, as well as quantities of power and floorspace for machinery and labour complements required at four different levels of output. Table 1 summarises the cost structure of the models.

The general aim in deciding on assumptions was to make the models useful and typical. Many of the assumptions were based on information given in a questionnaire (later referred to as "The questionnaire") by a fruit squash factory operating in West Africa. These include the geographical location of

the factory, the technique of production and many of the factor costs. The system of taxation used in the model is that of the country in which the actual factory is situated. Although the calculations have in most cases been made to a larger number of decimal places, the values quoted in the tables have been rounded to three significant figures. This may have given rise to discrepancies in totals.

## Scale and Type of Output

A rigorous method of investigating economies of scale involves balancing the lines of equipment to the output of the most expensive item. In the present case, the levels of output on which the models are based were suggested by a director of the firm of machinery makers which supplied information about many items of machinery used in the models; namely 300, 600, 1,200 and 2,400 26.2/3 oz bottles of orange squash. These were regarded as suitable scales of output for small firms in developing countries, and are commercially orientated since the soft drinks trade thinks in terms of hundreds of dozens of bottles. The models of increasing size are referred to as scales A, B, C and D. For each scale, three alternatives have been considered, namely, I, producing squash from oranges during the crop season of four months, and closing down during the remainder of the year, II, producing squash from oranges during four months and from imported compound during eight months, and III, producing squash from imported compound for the whole year.

The orange season lasts four months in the West African country mentioned above, and the factory which provided answers for the questionnaire actually made squashes from grapefruit, lemons, limes and pineapple, thus maintaining production during eight months. Squash may also be made from mangoes, guavas and pineapples by using different juice extraction machinery.

Some small fruit processing factories in the tropics make other products such as jam and chutney and canned fruit in addition to squash. The manufacture of animal feed and molasses from waste citrus peel is normally undertaken by larger factories than those under consideration here.

This report was restricted to orange squash since this is already a complex subject for a report. However, the information in the report as it stands may be regarded as a nucleus to which additional components may be added, and when the establishment of an actual orange squash plant is being considered, the raw material supplies and marketing prospects for expanding the range of products should be investigated. Alternatively, a local market survey, might reveal that the product would sell better in a smaller bottle containing say 10 fluid oz. or in locally available beer bottles. In this case fresh estimates of bottle requirements and costs and some fairly obvious adjustments to the operating system would have to be made.

Information on processing other products or advice on modifying the mode of operation can be supplied by the Tropical Products Institute.

## Mode of Operations

The models are assumed to operate on a single shift of eight hours a day for a 40 hour week. The working year consists of 240 days or 12 months of 20 days each. This simplification reflects sufficiently accurately, working conditions in developing countries where public holidays are frequent. Within the day, the running time is assumed to be 80 per cent of the total time, so that the machinery is working for at most 6.4 hours per day. The remaining 1.6 hours is allocated to cleaning.

### Techniques

In order to minimise both capital costs and the scale of production labour intensive techniques were chosen in preference to capital intensive ones. For example, the smallest automatic juice extractor which halves the fruit, extracts and sieves the juice would have cost in October 1967 about £2,650 delivered at factory, and has a maximum capacity of 2.3 tons of oranges per hour. A manually operated juice extractor costs £260 delivered and has a capacity of 600 lb. of oranges. Together with equipment for halving and sieving, the total cost was £777 (Table 4, i, 3, 4, 5). The second technique is still used successfully in developing countries where labour is relatively cheap, and makes small scale production commercially possible. The models have therefore been based on this method of juice extraction.* Similar arguments apply to the use of steam jacketed pans for pasteurising juice as opposed to the more capital-intensive pasteurisation process.

Given the method of production, the necessary equipment is listed in column a. of Tables 4 to 7. The number of items of each type of equipment (column h) depends on its capacity (column b), and on the weight or volume of material to be processed, which is stated at the top left hand side of each of Tables 4 to 7. The amount of material to be processed depends on the characteristics of the oranges (where they are used) and on the squash recipes.

### Assumptions about oranges

Oranges vary considerably in weight. For the purposes of this calculation, 10 oranges are assumed to weight 4 lb., which is approximate to the available information on weights of oranges produced in certain tropical countries.[10] As stated above the juice yield varies between 32 per cent and 45 per cent of the weight of the fruit. Here, it is assumed to be 40 per cent. With the method of extraction assumed, the yield depends on sorting the oranges into suitable sizes for the machine.

The specific gravity of orange juice varies between 1.03 and 1.06. All calculations involving specific gravity have been based on a value of 1.045.[11]

A certain proportion of the oranges are normally found to be unfit for processing. The waste factor is assumed to be 4 per cent of the oranges delivered to the factory.

### The Recipes

The recipe for squash made from oranges used in the calculation is one recommended for use in India.[12]. The quantities of oranges and other ingredients required are shown in column c. of Table 9. The recipe conforms with the requirements of the British Soft Drinks Regulations, 1964.[13] The recipe for squash made from compound was supplied by the firm which manufactures compound, except that the quantity of sugar was increased to that

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* The more capital-intensive machine, which is made in Italy, is evidently a recent model and became known at a later stage in the preparation of this report. It is probable that it would be economic to use it at the output assumed in the largest model, processing 1.34 tons of oranges per hour. An alternative calculation has not been attempted in the report. Details about the machine are included in Appendix I, and could be used in a feasibility survey.

specified in the recipe for squash made from oranges for the sake of comparability. Compound contains no sweetening matter. The quantities of materials required are shown in column c. of Table 10.

Power and Fuel

The power supply is assumed to be 400 volts, 3 phase, 50 cycles and the electric motors included in the quotations in tables 4 to 7 quoted for are suitable for this supply.

In the geographical area where the factories are assumed to lie, wood is plentiful and it is assumed that a common type of wood is used to heat the boilers. Wood is scarce in many developing countries, so that the effect on costs of using oil instead of wood is indicated in Appendix I on page 34.

Transportation

In the course of a feasibility survey, estimates of transport requirements and costs would have to be based on actual data for supplies and channels of distribution. In this report, estimates were attempted using some data on journeys supplied by the West African soft drinks manufacturer and reliable information about transport costs in the same country. The object of this was to make realistic estimates of transport requirements for a soft drinks firm in a developing country, and the order of magnitude of transport costs in relation to other costs. However, on the assumptions stated in pages 28 to 31, the costs of distribution are likely to have been underestimated (see below page 15).

Oranges. The oranges are assumed to be grown by peasants scattered over a fairly wide area. Although in many cases produce-processing factories pay for the raw material delivered at the factory gate, it is assumed in these models that the squash firms are responsible for transporting oranges, because this procedure gives them more control over the supplies. Since production of squash from oranges is seasonal, it would not be economic to own and operate vehicles for the purpose of orange collection only, so that where there is no surplus capacity in lorries owned for the purpose of distributing squash, it is assumed that hired transport is used for collecting oranges. Surplus capacity occurs only in case AI (Table 1, b, 20). Table 15 shows how the distances and necessary numbers of lorries have been estimated.

Distribution. Distribution of full bottles and collection of empties is normally undertaken by the producing firm in the soft drinks industry, and this procedure is assumed here. Again, distances and lorry requirements are calculated in Table 15. Table 16 gives estimates of transport costs, based on the distances calculated in Table 15. The firms are assumed to used their transport only for distribution and collection of bottles, and, in case AI, for collecting oranges. In reality, the lorries would be used for other tasks such as fetching materials. In the present calculation, all prices described as "delivered at factory" include an allowance for cost of transport.

Working Capital

"For a new project it is the cash on hand at or just before the start of commercial operations. It will be invested in stocks of raw materials and supplies, and in labour and other cash production costs. It will stay invested in the product while it is being processed, while it rests in

inventory as finished goods awaiting sale, and even after it is sold - until the customer finally pays cash for it".(13) In the present calculation separate estimates have been made, under the heading "stores", for stocks of main items of supplies testing equipment and spare parts. Labour and raw materials are treated as cash production costs for which provision has to be made initially.

Stores. Estimates of working capital for stores are shown in rows 21 to 29 of Tables 4 to 7. The stock of bottles is assumed to be enough for six weeks' production, i.e. 400 gross at scale A. At any moment there is two weeks' supply in the factory, half of which are full waiting to go out and half of which are waiting to be filled. The remainder are assumed to be out at depots, in retail establishments and private dwellings. The bottles are assumed to last on average for 10 trips, which is equivalent to saying that 10 per cent are lost each time they go out.

A six weeks' supply of cartons is also assumed. The cartons which hold 12 bottles can only be used once.

Testing Equipment. In practice soft drinks manufacturers in developing countries sometimes make use of the Government analyst's services for testing their products. Because quality control is very important and experts consider that each factory should have its own testing facilities, it has been assumed that all the models have a quality control scheme. Row 23 of Tables 4 to 7, shows the estimated cost of equipment and materials for this purpose, together with the labour complement.

Spare Parts. M. D. Bryce(14) recommends an allowance as high as 20 per cent of the total cost of basic machinery and equipment, because "the unavailability of spare parts for machinery is one of the great hazards of building a new industry in a non-industrial area." This allowance is shown in rows 24 to 26 of Tables 4 to 7.

Cash. The firms are assumed to operate on a cash basis, i.e., without giving credit. Consequently, cash resources to cover one month's operating expenses should be adequate. However the estimated working capital shown in row 9 of Table 1 is based on two months cash operating expenses to cover possible under-estimates under the "Stores" heading and to allow the firm a margin for the difficulties of starting up.

Depreciation

Depreciation is charged at 5 per cent on buildings and 10 per cent on machinery, and equipment. Depreciation for lorries is based on three or four years life depending on usage. (See Table 16).

Extra Allowances

Inevitably, the present calculation is bound to be less accurate and detailed than a final specification for an actual project which is expected to go into operation. Consequently Table 1 shows two extra items. In row 8, there is an allowance of 20 per cent on the total fixed capital costs to cover "installation and unforseens", and in row 28, a similar allowance of 10 per cent is made on total cash operating costs.

## 3 Outline of the Manufacturing Processes

### Buildings and Services

No attempt is made here to specify exactly the kind of building required. It is essential that it should be capable of being kept extremely clean. A single storey building of fairly light construction is assumed in this report, although in Britain the syrup mixing room is commonly on an upper floor so that the syrup can flow down into the bottling department. "Flooring should be firm and of good cement to withstand the constant use of water. A slope of about one quarter of an inch per foot is necessary for proper drainage. All doors, windows and ventilators should be provided with fine wire-gauze to prevent entrance of flies, wasps and other insects. The roof of the building should be high and well ventilated to provide outlet for vapours and steam. The windows should have large glass panes, and part of the roof should be of ground glass to permit a gentle light inside."(15)

Steam boilers are required in all cases where orange juice is processed (for pasteurisation) and also in case D III, where steam is used in the bottle washing machine. In all other cases, where squash is made from compound, only hot water boilers are required.

As shown in rows 10 and 14 of Table 22, very large quantities of water are required ranging from 1,200 gallons per shift in case A III to 6,500 gallons per shift in case D I. The water should be of good potable quality, with no bacterial contamination and virtually no colour or odour, and the water used in the final drink should not be too alkaline nor too hard since too much alkalinity would neutralise the acidity of the drink which contributes to its refreshing nature, while the use of hard water in squash may affect its appearance by reducing cloud stability (or opacity due to fine suspended particles).

Drainage facilities and an electricity supply are also necessary. In the absence of the latter, generating plant would be required.

About 60 per cent of the weight of oranges entering the factory is waste material and if this cannot be converted into animal feed, it must be removed from the factory area and dumped. In the latter case the main expenditure for disposal of waste would be the cost of handling and transportation from the factory site. In cases where there is a properly organised dump operated under the control of local authorities, it is unlikely that a charge would be made for dumping. If the factory operates its own dumping ground this might be made freely available as part of a soil improvement scheme.(16)

A firm in West Africa, processing 5 to 6 tons of fruit per day, reported that there are gutters in the factory floor into which all excess pulp, etc, is washed. This effluent goes into an external gutter which conveys it into a covered underground pit. On the way, the liquid passes through two fine wire mesh baskets which trap the solid waste matter. This waste is carted away with the peel in a small road-dumper to a disused gravel pit at a safe distance from the factory. The weight of the dumped waste might amount to about 40 per cent of the weight of oranges processed. The cost of this operation was said to be negligible.

No allowance has been made in the costing for waste disposal, apart from the allowance for unforseens at 10 per cent of cash operating costs in row 28 of Table 1. A careful estimate would have to be made in a feasibility survey.

Hygiene

Since squash is a food product, the highest standard of cleanliness is required for personnel, plant and buildings. When the equipment become contaminated, yeast bacteria or mould micro-organisms begin to appear in the finished beverage. Increased numbers of these organisms will cause ........ ultimate spoilage of the product."*

Hence, in these models, 20 per cent of the operating time is allocated to cleaning. Juice extraction may start as soon as the factory opens in the morning; meanwhile, the syruping and bottling equipment is being cleaned thoroughly before starting to operate. No juice or syrup should be left standing over-night, and in order to achieve this, the last batch may, in practice have to be a partial one.

Bottle washing should be synchronised so that a batch of bottles is ready for the first batch of squash.

"For carrying out sanitary operations in the plant, the following, at least, will be needed: A soapless cleaner for the equipment, as well as for maintenance operations: a chlorine sanitizer for the machinery that handles both the water (juice) and the syrup: a caustic base product for washing and sanitizing bottles; a product for polishing and removing stains from metals, tile and enameled surfaces; an abundance of hot and cold water; necessary brushes, sponges, pails and cloths, and a squeegee for removing excess water." (17)

These items have not been allowed for specifically in the costing, but are covered under the heading "Other Costs" in row 28 of Table 1.

Reception and Storage

Ideally, the oranges are carried by lorry to the factory in field boxes. As boxes are expensive, the fruit are usually brought loose in the lorry, from which they are unloaded and after weighing placed in storage bins. Although these may be of a high rectangular design with sloping baffles, which minimise pressure and allow the fruit to roll down to an aperture at the bottom, the bins may be simple tank-like wooden structures, in which the fruit may lie not more than three feet deep.(18) As stored oranges tend to deteriorate even within 48 hours, the storage space, consisting of horizontal bins, is designed for only two day's supply.

Washing

The fruit are carried in baskets from the storage bins, and fed into the hopper of the washing machine. Alternatively, the fruit could be conveyed in flumes, which may be made from halved 45 gallon oil drums and polythene sheeting. More running water would be required. (If essential oil were to be extracted from the skin, the process would be carried out before washing. However, it is assumed that there is no production of essential oil because it is not in demand.)

At scales A and B, the washing machine comprises a rectangular open topped tank mounted on legs, the whole being galvanised after manufacture. The tank is divided across the centre into two compartments end to end. On a

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*Chapters of the Book by Ruiz(17) deal with water and water treatment, plant sanitation, quality control and plant layout as well as with processing aspects of soft drink manufacture.

central drive shaft traversing the length of the tank are mounted two cylinders of perforated metal, one lying in each of the compartments. The fruit is fed by hopper into the first cylinder which revolves in heated water. A helical strip attached to the inner surface of the cylinder causes the fruit to move forward until it is picked up by elevator plates attached to the end of the first cylinder, which bring about the transfer of the fruit to a cold water rinse in the second cylinder. The manufacturer did not state the maximum throughput of this machine.

The larger washing machine used at scales C and D is of the tunnel type, the fruit being passed through the washing process, which also involves both hot and cold water, on a suitable conveyor.

A germicidal and detergent preparation may be added to the water, which should be changed continuously.

Sorting

After washing, the fruit is carried by operatives to sorting tables where it is inspected and defective fruit is eliminated. At this stage the fruit is sorted into different sizes, (small, medium and large) to facilitate a high rate of juice extraction, achieved by fitting the fruit to the extraction device.

Halving

The clean oranges are carried to the halving machine. This machine operates like a bacon slicer with a circular stainless steel blade 15 inches in diameter. The fruit are carried to the blade in cups situated on the edge of a rotary aluminium hopper, the cups being deeply grooved to allow access to the oranges by the blade. The operative's task is to drop the oranges into the cups and remove the halved oranges in clean buckets to the juice extraction machines.

Juice Extraction

The juice extraction machine is double-headed. Each "head" consist of a reaming rosette, a ribbed cone made of plastic or monel metal, and resembling a household lemon squeezer, mounted horizontally upon a spindle inside a bowl-shaped hood (monel metal is a corrosion-resisting alloy of nickel and copper). The rosette is rotated by the spindle while the operative holds the halved orange against it until the juice, pips and rag are extracted and fall into the hood, discharging into a bucket placed beneath. The hood and bucket are made of stainless steel. Rosettes are of different sizes.

Juice Separation

In scales A and B pips and rag are removed from the juice by centrifugal action in a cylindrical drum which is lined with an acid resistant lining. The juice pulp and pips are placed in a linen bag inside the drum, which is fixed vertically above a motor drive, when the drum rotates at high speed. The juice is expelled into the drum leaving the pips in the bag. The bags are kept sterile by washing with detergent and soaking in a chlorine solution.

At scales C and D, the extracted juice etc. is placed in a fruit sieving machine, in which the pulped fruit is forced through a sieve by paddles attached to a revolving shaft.

Pasteurising

Pasteurisation, in this context, has been defined as: "The treatment of liquid food products to ensure ..... the destruction of micro-organisms and inactivation of enzymes to enable food to be preserved for a prolonged or indefinite period". Conditions used for pasteurising citrus juices are primarily determined by the necessity for inactivating pectin enzymes, which are present in the original fruit or may be produced by micro-organisms which may enter the juice. It is necessary to remove these enzymes by heat treatment because they destroy the pectins which preserve the cloudy state of freshly extracted citrus juice. A juice from which cloud constituents have deposited as a sediment is less esteemed than a cloudy one.(19)

The juice is carried in buckets and poured into the steam jacketed pan(s). It is raised to a temperature of 190°F. and held there for 1 minute.(20) It is then poured into the blending vessel.

Syruping

The making of the syrup should be timed so that a batch of pasteurised juice and a batch of syrup are ready at approximately the same time to be mixed together in the blending vessel.

The cold process syrup-maker included in the specification includes an agitator and incorporates a cylindrical filtering unit with pump, fitted at the side of the machine.

The vessel is filled with the appropriate quantity of cold water (in accordance with the recipe in Table 9), the agitator is then switched on and the sugar which should be of the refined granulated type is introduced gradually. When all the sugar is in the vessel the pumping unit is switched on to circulate mixture of sugar and water, through the filter and back into the vessel. This system of circulation ensures the dissolving of sugar granules and will provide an even mixture. If a lighter and cheaper syrup is required, saccharine may be substituted for part of the sugar. (According to the British Soft Drinks Regulations, 1964 the maximum quantity of saccharin permitted in orange squash is 280 grains per 10 gallons).(21)

Although it is common practice for the syrup room to be situated on the first floor of the buildings, so that the syrup flows by gravity into the blending vessel, a single storey building is assumed in the present calculation, and the syrup is pumped into the blending vessel.

Blending

In the stainless steel blending vessels, which are also equipped with agitators, the pasteurised juice and syrup are mixed together with the other ingredients as listed in Table 9. These are sugar, citric acid, essence of orange, orange colour and preservative. The latter is potassium metabisulphite which is used as a source of sulphur dioxide. According to the Indian Fruit Products Order, the maximum amount of sulphur dioxide allowed in squashes and cordials, is 350 parts per million. This corresponds to about 2 ounce of potassium metabisulphite per 100 lb. of squash.(22)

The blending of orange squash from compound differs only in that there are fewer ingredients. (see Table 10).

In the smaller units, the squash is led from one of the blending vessels by means of a flexible hose coupling. At scale D an additional pump might be used.*

Filling

At scales A, B and C, filling is effected by simple hand operated syphon machines having either six or eight spouts. In this machine, there is a stainless steel trough which holds the squash ready to be filled. The bottles rest on a stand in front of the machine, and the squash is syphoned into them through steel tubes. The bottles are removed by hand and taken to the capping table.

At scale D an 18-headed vacuum-assisted bottle filling machine is assumed to be used. The surfaces in contact with the squash are made of stainless steel. With this type of machine, the air is drawn out of the bottle by a vacuum, which facilitates filling. The bottles are automatically fed to and discharged from the filling valves.

In all cases the bottling, capping and labelling machines are placed close to each other. Some additional unskilled labour or a conveyor belt may be required to move bottles at this stage.

Capping and Labelling

It is assumed that re-usable crown caps with a polythene insert are applied since they facilitate storage of the squash after the bottle has been opened.

At scales A and B, the caps are put on by a small hand-operated machine and the labels are pasted on by hand. At scale C, semi-automatic capping and labelling machines are used. In the former, the crown is mechanically placed upon the bottle and sealed by a hand-operated lever. The latter machine has a magazine, in which a pack of labels is placed. The operator places slight pressure on the foot treadle of the machine to actuate the complete labelling sequence in which the label is taken from the stack, placed on bottle and wiped round the surface of the bottle.

In scale D, both the crowning and labelling machines are fully automatic.

Bottle Washing

As the scale of operations increases, bottle washing is carried out by machines of increasing complexity. The simplest consists of a rectangular tank with a brushing unit, in which the bottles are washed in hot water and then rinsed. At scale D, a larger machine of the tunnel type is assumed. The bottles are loaded onto a conveyor which carries them into the interior where they are sprayed with hot and cold water and the labels are removed mechanically. As mentioned above, the hot water should include a detergent solution of caustic soda (80 per cent) and Calgon (20 per cent) to sterilize the bottles and facilitate removal of labels.

The bottles are carried to the filling unit either by hand in crates or at scale D by conveyor.

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*The price of the centrifugal pumps covered in the specifications in Tables 4 to 7 was £64. 10s. 0d. f.o.b. London in mid-1967. No pump has been included with the blending vessels.

Storage

Full bottles are placed in cartons and carried by hand to the store except at scale D where a conveyor is used. The labour for this task is shown in row 22 of Tables 4 to 7.

Quality Control

The maintenance of standards of purity and uniformity in the product is of great importance in the manufacture of orange squash and other soft drinks, and it is essential that the manager of the factory should be capable of supervising quality control tests which may be carried out by semi-skilled staff in a suitably equipped testing room.

It may be considered necessary to test samples of the oranges before acceptance for maturity. This involves determining the ratio between the proportion of total soluble solids (primarily sugar) and the proportion of citric acid in the juice. Values of the ratio within a certain range, make the juice acceptable for processing.

A normal commercial quality control system would involve performing the following tests in the course of production.

Each batch of syrup should be tested for the sugar content, so that this can be adjusted before blending.

Before bottling, each batch of the blended squash should be tested for the following attributes: flavour by taste, appearance by inspection, sugar content and acidity. The last two tasks require apparatus. Finally, the preservative content of the squash has to be checked. Since the commonest faults are the omission of preservative, or the addition of a double dose, a roughly quantitative test for sulphur dioxide should be done on every batch. Direct titration with iodine is considered adequate by the trade and takes less than five minutes. Where, as in Britain, there is a maximum limit for the amount of preservative in squash, a more rigorous test requiring relatively expensive equipment and taking from one-and-a-half to two hours is necessary. In order to avoid holding up the flow of production, this is normally done after the squash has been bottled, and acts as a "police" check.

In order to test the efficiency of pasteurisation, a sample bottle from each batch should be kept for fourteen days to ascertain whether the cloudy appearance of the beverage is maintained.

Finally, there should be periodic checks to ascertain the presence of yeast, moulds and bacteria, and remedial action taken if high levels of contamination are detected. In the first instance, expert assistance must be obtained to carry out the necessary tests, but factories operating at scales C and D should aim to become independent in this respect.

## 4 The Results of Costing the Models

### General Observations

Tables 4 to 20 of the report show the physical quantities of equipment and other imports required for producing squash from fresh oranges or compound.

All quantities apart from fixed capital (which is shown in Tables 4 to 8) are given on the basis of requirements for one shift of 6.4 operating

hours. Quantities of raw materials and supplies are given in Tables 9, 10 and 11 for scale A only; i.e. they relate to the model factory producing at the rate of 300 bottles per running hour. The quantities appropriate to scales B, C and D can be easily derived by simple multiplication.

None of the other factor inputs increase in simple ratio from model to model, so that the required quantities for operating one shift are shown separately for each model. Tables 12 to 14 deal with electric power, wood fuel and water. Transport for orange collection and squash distribution are dealt with in Tables 15 and 16. Personnel is covered in Tables 17 to 20.

The situation of the factories is assumed to be well endowed with wood suitable for fuel. In many developing countries wood fuel is not available. In such cases oil might be used as an alternative, which would entail certain changes in capital and operating costs. Some information relating to these changes is given in Appendix I.

Values of all items are shown in the tables at prices in sterling in mid-1957 delivered at a West African factory, and in nearly all cases where the item is imported at the prices f.o.b. British port. (At that date sterling and the West African currency were at par.) Costs per shift have also been worked out.

In Table 1, the estimated capital costs are entered in rows 1 to 9, and the operating costs per shift from other tables have been multiplied by the appropriate numbers of shifts shown in the column headings and entered in the relevant columns. Sources or methods of estimation for each row are entered in column n.

Before considering the implications of Tables 1 to 3, it is necessary to emphasize that these results depend on the assumptions described in Chapter 2, and might be different in different circumstances, an illustration of which will be given below.

As they stand, Tables 1 to 3 represent the factor cost situation in a West African country in mid-1967 and although there must be a margin of error, they are considered sufficiently accurate to enable ordinal comparisons to be made between different methods of operation and different scales of operation, and also to indicate the relative importance of different cost items.

A reservation must be made with regard to the estimated costs of distribution and advertising. It can be seen from column m, rows 22 and 26 of Table 1 that the cost of distribution and advertising amount to only 4.7 per cent of sales cost, whereas recently published figures for an actual Nigerian brewery, showed that these items in 1964 comprised 12 per cent of turnover.(23)

The cost of distribution in the models was based on minimal assumptions with regard to full loads and length of journeys. Consequently, estimates based on an actual market situation, together with a higher estimate for advertising expenditure such as 5 per cent instead of 4 per cent on turnover, are likely to raise the estimated cost of these items so reducing profits (row 35 of Table 1) to a more normal level.

In looking at capital costs in Table 1, the main point to be notices is that the estimated costs of stores and working capital together exceed the cost of machinery and transport equipment, and amount approximately to between half and two thirds of the total capital costs shown in row 1. Since working capital is based on two months operating costs rather than one, it may be an over-estimate in relation to normal operation. However, the need for adequate working capital when starting an undertaking must be emphasised.

The cost of oranges (row 10 of Table 1) is a very low proportion of total sales cost (row 33), being 3.1 per cent in case AI and 2.4 per cent in case DI. This means that the cost of oranges could double without having an appreciable effect on profit. However, orange prices appear to vary very greatly, and in 1966 according to a private source, the price paid to the grower in Bolivia was said to vary from 2d. to 5d. per lb. compared with 0.589d. per lb. (or 110s. per ton) assumed in this calculation. At 5d. per lb. the cost of oranges in Case AI would be £4,664 instead of £491 and there would be a net loss of £100 instead of a net profit of £4,073. It is thus not surprising that in Bolivia most orange drinks are made from imported concentrate.

It may be mentioned here that it is sometimes possible to stabilise the seasonal price of oranges bought from farmers by contract buying of the crop in advance.

The relative importance of various operating costs are more easily seen in Table 2, which shows various items in group totals which have been related to output expressed in hundred dozen bottles (row 1). Row 4 gives totals for raw materials and supplies. These constitute a very high proportion of total sales costs (row 20), ranging from 5·2 per cent in case AI to 79 per cent in case DIII.

Economies of Scale

Comparing like with like in row 21 of Table 2, reveals that the unit costs fall as the scale of output increases. The fall is greatest between cases A and B, and tapers off between cases C and D. The same result is expressed in terms of increasing returns to scale in row 36 of Table 1. The gross rate of return on capital doubles from 18 per cent in case AI to 36 per cent in case BI. There is a more moderate increase to 44 per cent in case CI. The slight fall between cases CI and DI is probably due to errors of rounding. At D the capping, labelling and bottle-washing machines become fully automatic, and although the unit cost curve appears to level off at this point, it would not be correct to expect unit costs for plants larger than D to increase. Further economies might accrue from larger fully automated units, and from the introduction of fully automatic juice extraction. Indeed, the calculations in Table 2 tend to disprove the assertion of Staley and Morse that bottled soft drinks belong to a group of industries in which "transfer costs of the finished products are high in relation to potential scale economies", and sufficiently high to inhibit the incentive to gain a moderate advantage by serving several markets from a central plant.(24) According to row 11 of Table 2 the cost of transportation (about 75 per cent of which is the cost of distribution) tends to decrease with increasing scale in cases II and III where vehicles are more fully utilised owing to all-year operation. This is due to the fact that transport is subject to its own economies of scale arising from the more economic use of larger vehicles. It can be seen from Table 16 that the load capacities of vehicles increase at a higher rate than their cost.(25) It must be emphasised that these results are influenced by the assumption that the average length of journey remains constant, while scale increases.

Confirmation for the effect of economics of scale leading to concentration in the soft drinks industry (of which orange squash is part) is provided by Kenya. There, between 1961 and 1963, "establishments fell from 21 to 18, persons engaged from 854 to 752, yet production rose from £1.1 million to £1.3 million, thus indicating a greater degree of concentration in the industry."(26)

However, it is possible that small or moderate sized firms might be viable in some circumstances. Obvious examples are island communities or areas which are isolated owing to bad communications. Alternatively, existing firms might be precluded from getting larger (and taking advantage of economies of scale) by lack of investment funds, which might be available to a new comer. Further, it is possible to attract customers by higher advertising expenditure and to attach them by means of specially efficient service or high quality of product.

Finally, a reference should be made to the very small soft drinks firms which flourish in developing countries. For example, according to the Industrial Survey, Nigeria, 1963, the soft drinks industry contained, (besides 15 larger firms) a large number of small producers of mineral waters, employing less than 10 persons.(27) Orange squash can also be made on a cottage scale. It is possible that such little firms survive by employing family members and charging very low prices to a limited number of customers.

Some information has been collected regarding equipment and other inputs required to produce 10 x 26.2/3 oz. bottles of orange squash per half day of 4 hours. This has not been included in the report mainly because at this level of output, it is not possible to prescribe the measures for maintaining the high standards of hygiene and quality which are necessary in the food industry.

Oranges or Compound or Both?

Row 21 of Table 2 shows that for scales B, C and D the lowest unit cost is achieved in case I where oranges only are processed for four months of the year. In all the models, the highest unit cost appears in case III, where no oranges are processed and compound is used all the year round.

This appears to be due to the predominant weight of the cost of raw materials and supplies (row 5 of Table 2) the unit cost of compound being considerably higher than that of oranges. In comparing case II with case I for each model the main source of saving on unit cost is due to running the plant all through the year instead of for four months, and in comparing case III with case II, additional savings result from dispensing with the equipment and labour required for orange processing. Except for "miscellaneous" (row 15) all the other unit costs in Table 2 are affected by these savings. However they are not large enough in aggregate to offset the increase in raw material costs between cases I, II and III except in model A. Here, certain unit cost items are exceptionally heavy in case I, for example, manpower (row 13) owing to the fact that one manager and two supervisors are assumed to be employed all the year round, and depreciation (row 19) because utilisation of equipment is lower than in other models. The impact of savings in these unit cost items is sufficiently heavy to reverse the trend observed in other models.

However, from the firm's point of view, the choice of model would be affected also by the initial investment, which varies from case to case. The initial investment is brought into the analysis through the rate of return. The gross return on capital, which is shown in row 36 of Table 1, is sales revenue (row 34) less total annual sales cost (row 33) expressed as a percentage of total capital costs shown in row 1. At all scales, the rate of return in case I is much lower than in the other two cases. This is to be expected because the equipment is only utilised for one third of the year, compared with the whole year in cases II and III. For scales B, C and D, the rate of return is higher in case II than in case III, while for scale A, the

rate of return is highest in case III. The commoner pattern is due to the cost saving resulting from using oranges rather than compound for a third of the year. For scale A, this effect is offset by a much greater proportionate fall in capital costs between cases II and III, when orange processing is eliminated. It should be remembered that the commoner pattern could be reversed if the price of oranges were higher. Also, if the orange season were longer, or if other citrus fruits could be processed so as to extend the production period to the whole year, or a large proportion of it, the rate of return for case I at each scale would be considerably higher.

The further possibility of processing enough juice during the orange season to keep the bottling line in operation throughout the year has not been fully investigated in this report. Additional investment would be necessary. For example, sufficient juice to run the bottling line in scale C could be processed by having twice the capacity of juice extracting machinery, as in case D, and running it on single shift during the first and fourth month of the orange season and on double shift during the two middle months. The necessary amount of juice with preservative added could then be stored in waxed wooden barrels in an air-conditioned storage chamber until required for use. Information about the quantities and costs of barrels required, storage space and the estimated cost of air conditioning equipment is given in Appendix I.

The main arguments in favour of using compound all the year round are the lower initial investment required and the greater simplicity of the process which obviates pasteurising, while the problem of variation in the raw material is obviated. In this report, it is assumed that the compound is imported, so that there is a continuous foreign exchange cost. This need not necessarily be the case, and in developing countries where the fruit processing industry is well established, firms engaged in large scale juice concentration or comminution may make compounds for the use of the soft drinks industry. Compounds comprise concentrated juices plus flavour, acid and colour,[28] while simple concentrated juice or comminuted bases[29] may also be used. Compounds etc. may require cool storage, depending on the circumstances. Some costing information for cool storage of the quantities mentioned in this report are given in Appendix I.

Given the factor costs assumed in this report, there appears to be a slight advantage in using fresh orange juice for part of the year despite the somewhat higher capital cost. The use of locally produced orange juice all the year round involving higher capital costs for air-conditioned storage and extra juice processing machinery might be justified by the saving in foreign exchange and the provision of extra employment opportunities. This is a suitable subject for social cost benefit analysis, which is outside the scope of this report.

## The Effect of Taxation

Table 3 shows the effect of the taxation system in the West African country upon the results as calculated in Table 1. The industry has no Pioneer Status so that it is necessary to take account only of initial and annual capital allowances, when deducting from profits, tax at the rate of 8s. in the £1. The Table is self-explanatory with regard to rates of allowance.

Since the tax system operates at the same rates on each of the models, there is no change in the ordinal comparison. The inclusion of taxation in the models serves only to bring them a stage nearer to reality, and to act as a check on the calculation in general. A soft drinks firm operating on a fairly large scale in West Africa stated that they expect a return on capital

after tax from 25 to 30 per cent. The rates of return shown in row 11 are after tax and depreciation. They are thus high in relation to the firm's statement and suggest that errors of estimate have the cumulative effect of underestimating costs, and/or overestimating revenue.

Recommendations

The foregoing section serves to reinforce the opinion stated earlier in this report that the decision to set up an orange squash factory should be preceded by a very careful local investigation including a costing in terms of local factor costs and expected revenue. Blank spaces have been left in many of the tables to facilitate the task of anyone who wishes to make the attempt.

It should be stressed that the results as set out in Tables 1, 2 and 3 and discussed in this chapter assume a continuous output at an operating efficiency of 80 per cent and somewhat lower levels of overall efficiency as may be deduced from the utilisation factors given in columns c of Tables 4 to 7. Thus at scale C, the utilisation factors range from 36 per cent at the sieving machine to 72 per cent at the capping machine, so that the overall efficiencies range from 29 per cent to 58 per cent; indicating a not unduly optimistic level of performance. However, in reality a factory might produce at even lower rates in the early stages of production. In order to allow for such variations in output over time and for variations in income owing to the tax system, such as exemption from tax over an initial period in the case of a Pioneer Industry, the discounted cash flow method of appraising different investment projects should be used. This method has other advantages, a discussion of which is outside the scope of this report. It has not been used in this report since the ordinal comparison between the models would not be affected and because the absolute rates of return, which would be affected, are not thought to be very critical, at this stage.

## Part II

### Methodology

1. Sources of Information.

The information used in compiling this report has been gathered from firms (mainly British), research institutes including other departments of the Tropical Products Institute, British Government departments and overseas representatives, and from publications. The organisations which have supplied information used in the report, and published sources are listed in Appendix II.

In order to supplement the machinery makers' specifications as to the performance of machines and labour requirements and to secure additional facts, fairly detailed operational surveys and/or interviews were carried out at three British factories manufacturing soft drinks. As there is no firm in Britain engaged in the extraction of juice from oranges for the manufacture of squash, a detailed questionnaire was constructed with the intention of obtaining operational and costing information from overseas firms engaged in processing oranges for the manufacture of squash. The questionnaire could be filled in easily by someone with experience of industrial surveys or knowledge of the industry in question. However, it requires a skilled personal approach to secure the co-operation of a firm in an operational and financial survey, and, although some attempt was made to place questionnaires indirectly, it is not surprising that only one questionnaire was received from a firm manufacturing squash in West Africa. The information supplied in this questionnaire and several supplementary letters has been of great value, and together with published information relating to factor prices in the country in question, it has formed the basis of the costings and financial calculations included in this report, as well as serving as a guide to operating practice. The identity of this firm and the country in which it is situated are not disclosed in the report partly to avoid disclosing information which was given in confidence, and partly because in certain respects the models are fictional and it was desired to obviate giving the impression that they could be identified in their entirety in a particular country. However, since many of the costings such as the cost of transport from the West African port and the rent of land should be consistently related to a particular site, all values for such items pertain to the actual site of the factory, whose manager answered the questionnaire.

2. Methods of Calculation

The general concepts upon which the models have been based are outlined in Part I, pages 4-8. The following notes describe item by item how the tables were calculated. References are made to row numbers and column letters.

*Table 1 Costs and economics of scale in the production of orange squash from natural orange juice and compound.*

Most of the figures in this table are derived from other tables in the report; sources for each row are given in the final column n. More detailed explanations of certain items are given below.

Row 8 Installation and unforseens. Since it is impossible to foresee all the items of expenditure which are likely to occur and certain minor items are better left to the final planning stage, an allowance of 20 per cent of other capital costs has been included. This covers such items as land clearance, office equipment, port handling charges, handling equipment such as wheelbarrows or (for the larger models) conveyors.

Row 9 Working capital. The amount of working capital required at the outset has been based on two months' cash operating costs. The undertakings are assumed to operate on a cash basis so that the normal average period between payment for factors and receipts for the finished product might be of the order of three or four weeks, once the rhythm of production and distribution has been established.

Row 16 Maintenance on Machinery. An expert(31) has recommended that 5 per cent of annual sales should be used as a minimum for estimating this item. In the present context this method of estimation would yield anomalous figures, since less machinery is required in cases III for the same value of sales as in cases II. Therefore maintenance on machinery has been estimated as 20 per cent on the capital cost of machinery in cases I and 40 per cent in cases II and III. The fact that a stock of spare parts is allowed for in Tables 4 to 7 below does not eliminate maintenance as an operating cost item, because the parts should be charged to operations as they are used.

Row 26 Advertising. The figure of 4 per cent on sales was derived from a survey(31) of the fruit processing industry in India.

Row 27 Interest on working capital. A long established export and import firm gave 8 per cent per annum as a reasonable charge in the circumstances. As the case I models operate for only four months, interest is charged at the rate of 4 per cent to allow for partial closing down.

Row 28 Other costs. This is an allowance for items which may have been under-estimated or omitted(32). For example, it might be necessary to have an extra employee, apart from the manager and supervisors, responsible for buying oranges.

Row 34 Sales revenue. The net delivered price of squash in a 26.2/3rds oz. bottle was taken to be 32.40d. including 6d. returnable deposit on the bottle. This estimate was based on information given in the questionnaire. A merchant operating in West Africa in this industry confirmed that it is correct to charge the same for squash made from oranges as for squash made from compound.

*Table 2. Capital and operating costs per hundred dozen bottles of orange squash.*

The figures in this table are derived by division from those in Table 1 and require no further explanation.

*Table 3. The effect of Local Taxation on Net Profit, Rate of Return and Pay-Off Period.*

In Table 3, the company tax system has been applied to the capital and revenue items derived in Table 1.

It appears that the soft drinks industry has not been accorded Pioneer Industry status, so it is assumed that there is no question of exemption from tax for an initial period.

The annual allowances at 5 per cent on buildings (row 2) and 10 per cent on plant (row 3) have been deducted from gross profit (row 1) to yield taxable adjusted gross profit in row 5. From the latter figure is deducted company tax at 8s. in the £1. to yield profit after tax in row 7. Row 8 shows net profit after depreciation and tax.

Tax allowances are given for capital expenditure in the year in which it is incurred. In this calculation this initial allowance is dealt with by deducting the tax avoided from total capital costs (row 9) to yield residual capital cost after allowances in row 10. The allowance on plant is made at the rate of 40 per cent, and that on buildings at the rate of 20 per cent. The tax avoided on these magnitudes is at the rate of 8s. in the £1. as before.

The initial allowances of 10 per cent on plant and 5 per cent on the cost of the buildings have been dealt with by deducting the tax avoided from the initial capital. The result is shown as residual capital in row 10.

The rate of return on residual capital is calculated after tax and depreciation and shows in row 11.

The pay-off period is calculated after tax and before depreciation on residual capital and shown in row 12. This method of assessing investments is regarded by Alfred and Evans(33) as open to less criticism than any of the methods other than the discounted cash flow.

*Tables 4 to 7, Scales A, B, C and D. Quantities and Costs of Equipment and Stores. Quantities of Power, Floorspace and Labour.*

Columns b, d, e and f. The information in these columns was collected from manufacturers of machinery and other equipment.

Columns c and h. The utilisation factor is the total throughput at each stage, as stated in the headings of each table on the left hand side, expressed as a percentage of the total capacity of the number of units required in each section (column h). The number of units in each section has chosen to yield utilisation factors in general not above 75 per cent, allowing a margin of extra capacity which could be utilised in practice by putting on extra operatives. For scales C and D the utilisation factor of the halving machine(s) has been allowed to rise above 75 per cent and in these cases the operative complements have been appropriately increased.

The steam jacketed pans (row 6), cold process syrup makers (row 8) and blending vessels (row 9) are made by the manufacturer, who gave information for this report, in two sizes only, namely 50 gallon and 100 gallon. The numbers of each item required for processing the throughput at each stage depends not only on the time required for processing but also on the time required for pumping the liquid into and out of the vessels. The pumps which are included in the specifications are capable of a delivery up to 1,000 gallons per hour; the rate assumed in the calculations being 400 gallons per hour. The estimated processing time for pasteurising approximately 30 gallons of orange juice at scale B is given below.

| Operation | Minutes |
|---|---|
| Pumping juice in and out | 9 |
| Estimated time to raise 15 gal. of juice from 60°F to 190°F | 14 |
| Holding time | 1 |
| | 24 |

One 50 gallon pan is thus adequate to deal with the throughput at both scales A and B.

In the case of syrup mixing pans the loading has been based on the machinery makers' claim(34) that these machines can process a quantity of syrup equal to twice this capacity in one hour*. There is in fact some excess capacity; e.g. at scale B, only approximately 70 gallons of syrup per hour have to be processed in the 50 gallon pan. At scale D an extra 100 gallon mixing pan has been allocated. This gives some additional capacity which might be used in conjunction with the highly productive bottling machine when using compound.

It is necessary to have one blending vessel in excess of the net capacity required for one batch of squash which is ready for bottling while the remainder is being prepared.

Column f and g. The prices of items of equipment f.o.b. United Kingdom port and delivered at the factory have been estimated by using information on the cost of packing and carriage to a United Kingdom port and sea freight given by machinery makers and other firms. In most cases the estimated f.o.b. value was 8 per cent above the ex factory price while the estimated c.i.f. value was 18 per cent above the ex factory price. Two per cent was added to the c.i.f. price to allow for internal transport to the factory. No allowance has been made for West African port dues or handling charges.

The f.o.b. and delivered prices of lorries are as stated by a firm which supplies lorries and operates transport in West Africa.

According to suppliers, the c.i.f. value of the bottles is about 137 per cent of the f.o.b. value.

The soft drinks industry in the country in question has not been declared a "pioneer" industry with exemption from import duty. However, machinery for the making of orange squash, boilers for industrial purposes and laboratory equipment enter duty free. The duty on imported lorries (rows 19 and 20) is 33.1/3rd per cent on the c.i.f. price, which partly explains the large margin between the f.o.b. and delivered prices. Part of the difference is due to the £200 cost of a locally made wooden body. The duty on bottles and closures is 33.1/3rd per cent on the c.i.f. value.

The cost of testing equipment (row 23) is not easy to estimate, since much of it consists of glass equipment of unpredictable durability, which may or may not be available for purchase in a developing country. Scrutiny of two independent assessments for plant and equipment for fruit processing factories in developing countries revealed that in both cases, the estimated requirements for laboratory equipment and supplies amounted to about 6 per cent of the value of processing machinery. This percentage, applied to the cost of processing machinery including juice extraction is the basis of the figures in row 23 of Tables 4 to 7.

The ex-factory British price (mid 1967) of various items of equipment required for the tests and the estimated c.i.f. West African values are given overleaf:

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*Checking the times empirically was not possible because syrup mixing tends to be kept secret in British factories.

Two refractometers for testing the sugar content of syrup and squash.

| | ex factory | c.i.f. |
|---|---|---|
| $15^o$ - $55^o$Brix | £18.25 ) | £41.875 (air freight) |
| $40^o$ - $85^o$Brix | £22.50 ) | |

Set of glass apparatus for acid test.

| ex factory | c.i.f. |
|---|---|
| £2.89 | £3.81 (sea freight) |

Set of Monier Williams apparatus for preservative test.

| ex factory | c.i.f. |
|---|---|
| £23.28 | £31.27 (sea freight) |

A check was made to establish that the sums estimated in row 23 are sufficient to cover adequate quantities of the above apparatus both in use and in stock as well as a stock of chemicals and furniture, in countries where these items cannot be purchased locally.

Column 1. top. Labour requirements have been based upon machinery makers' recommendations, and upon information derived from surveys and the questionnaire, and are considered to be adequate to cover handling at all stages as well as productive work. It will be noticed that a complement of non-skilled operatives has been allowed in each case for handling finished goods (row 22). Transport operatives shown in rows 19 and 20 are not included in the totals (rows 30 to 32) because transport is costed separately in Tables 15 and 16. Sixteen operatives are allocated for this purpose at both scales C and D. The number has not been doubled in scale D (to allow for twice the output) because it is assumed that there is a gravity roller case conveyor for transporting packed bottles into the store. The item has not been costed separately since to do so would involve having an accurate scale plan of the factory which is not necessary at this stage. The cost is allowed for in row 8 of Table 1 (installation and unforeseens).

*Table 8. Factory Floorspace and Site Area*
*Initial Cost of Buildings and Annual Cost of Repairs. Annual Rent of Land.*

*Table 21. Floorspace for Storage and Processing. Total Site Area.*

The composition of the total building area is shown in detail in Table 21.

Row 1 of Table 21. The calculation of storage space rests on the assumptions outlined in Part I. An examination of the relation between the dimensions and weight of contents of standard orange boxes showed that about 40 lb. of oranges occupy 1 cu. ft. The space allowed for storing oranges is twice the net amount required to store in bins two days supply of oranges lying not more than 3 feet deep. The additional space is required to allow for handling and for the extra 4 per cent of fruit assumed to be wasted. Thus in case AI, two days supply is 375 lb. x 12.8 hours = 4,800 lb., so that the total space required would be $\frac{4{,}800 \times 2}{40 \times 3} = 80$ sq. ft.

This figure appears in Table 21 at 1c.

Rows 2 and 3 of Table 21. The total floorspace for production areas has been derived by multiplying the net floorspace totals shown in rows 17 and 18 of Tables 4 to 7 by a recommended factor of 3. (If an allowance is being made for expansion, the factor should be 5.)(35)

Rows 4 and 5 of Table 21. The calculation of storage space for bottles has been based on the assumptions that the area of the base of a carton holding 12 x 26.2/3rds oz. bottles is 10 in. by 13 in. Full bottles can be stacked 7 cartons high and empty bottles 6 cartons high. Storage space was estimated sufficient for a week's supply of empty and full bottles. The width and breadth of two cases in each direction was allowed for alley ways at scale A. The approximate areas for scale A are 230 sq. ft. for empties and 200 sq. ft. for full bottles.

Row 7 of Table 21. The maximum ground area occupied by buildings can be as low as 0.3 of the site area. In the present study the site area has been estimated by doubling the building area.(35)

Column d of Table 8. The cost of buildings in developing countries varies widely. The figure of £1.15s. per sq. ft., which has been used in the calculation was suggested by a firm of merchants and manufacturers with wide experience of the country for a simple building with a concrete floor and prefabricated roof using mainly locally produced materials. A figure of £5.3s. per sq. ft. was quoted by another firm in respect of a more elaborate soft drinks factory built in a neighbouring country during the 1960's using materials entirely imported from Britain.

Column e of Table 8. The cost of repairs at £12 per 1,000 sq. ft. was based on information given in the questionnaire. In addition there would be a small charge for insuring the building, for which no estimate has been made. As only one shift is being worked, no lighting cost has been included.

Column f of Table 8. The factory is assumed to be situated on an industrial estate, providing roads, drains, electricity, water and telephones, the current rent for which might be £100 per acre.

*Table 9. Quantities and Costs of Materials per Shift for squash made from Fresh Orange Juice. (Scale A. 300 x 26.2/3rd oz. Bottles per Running hour.)*

Column c. The quantities given here are based on an Indian recipe(11) for squash intended for commercial production.

Column e. The local prices of sugar, potassium metabisulphite (used for making the 9 per cent solution of sulphur dioxide) and oranges were taken from the questionnaire. Those of orange extract, NRS, and orange colour were based on a duty paid landed cost, calculated by the supplier, to which was added 2 per cent to allow for transport to the factory. The price of citric acid in column f was estimated from the f.o.b. value quoted by a supplier.

Import duties on various imported materials were 3½d. per lb. for sugar, 33.1/3rd per cent on the c.i.f. value for citric acid, orange colour and potassium metabisulphite and 50 per cent on the c.i.f. value of orange extract. The seasonal costs of raw materials shown in Table 1 can be derived from column f. of this table by multiplying by 80 shifts for scale A and by scale factors of 2, 4 and 8 for scales B, C and D respectively.

*Table 10. Quantities and Costs of Materials per Shift for Squash made from Orange Compound (Case A. 300 x 26.2/3rd oz. Bottles per Running Hour.)*

Column c. The quantities shown in this column are based on a recipe given by the firm which supplies orange compound. The original recipe allowed 4 lb. of sugar to 1 gallon of squash. This would give a squash of about 35° Brix. (The Brix scale denotes the percentage by weight of sugar in a solution.) As shown in the heading of row a. of Table 9. the natural orange squash is 45° Brix. Since customers would be unlikely to accept a squash made from compound less sweet than that made from fresh juice, the proportion of sugar was increased to 5.41 lb. per gallon of squash.[36] The sugar content of the two squashes is thus approximately the same.

Columns e. and f. The f.o.b. price and the duty paid landed cost of the ten-fold orange compound are as stated by the supplier. An addition of 2 per cent has been made to cover transport from the port to the factory.

The ad valorem rate of duty on compound is 50 per cent on the c.i.f. value.

*Table 11. Quantities and Cost of Supplies per Shift ( (Scale A. 300 x 26.2/3rd oz. Bottles per Running Hour).*

Columns c. and d. A 10 per cent loss of bottles was considered a reasonable allowance by members of firms with overseas experience. The cardboard containers and the closures are disposable.

Column f. The prices of containers and labels were taken from the questionnaire. The prices of bottles (see footnote 1 of Table 11) and of closures are based on information given by suppliers. The cost per bottle is 13.4d. If a deposit of 6d. is charged, the replacement cost is 7.4d.

The rate of duty on bottles and closures is 33.1/3rd per cent on the c.i.f. value.

*Table 12. Quantities and Costs of Electric Power.*

Column c. Kilowatt hours (kWh) have been based on the totals for horsepower (HP) of electric motors shown in column j of Tables 4 to 7. To allow for the fact that the machines do not have to run for the whole assumed running time of 6.4 hours per shift, in order to process the required throughput at each stage, the highest utilisation factor in each case (see columns c. of Tables 4 to 7) has been used to make a rough estimate for the period during which the machines actually run. These utilisation factors are 0.62 for scales A and B, 0.78 in scale C and 0.82 in scale D.

The 19.0 kWh for case AI (c.1 of Table 12) is derived from Table 4, (17.j.) as follows, assuming normal three phase supply.

4.785 HP x 0.62 (maximum utilisation factor) *
x 6.4 (running hours) = 19.0 kWh.

* A more accurate formula for estimating kWh from HP is kWh = (HP x 0.746) ÷ (PF x EF), where PF = power factor and EF = efficiency factor. The simpler formula, which may be used in cases where the power factor and efficiency factor are not known, as in this case, tends to underestimate electricity requirements.

Column d. Charges for electricity in the country are in the form of a two-part tariff, consisting of a monthly demand charge, based on the maximum demand by the consumer during the month; and a running unit charge. The relevant part of the monthly demand charge is given below.

| Maximum demand in KVA | Fixed Charge per month s. | d. | |
|---|---|---|---|
| Up to 10 .......... | 30 | 0) | |
| 11 to 25 .......... | 27 | 6) | per KVA or part thereof |
| 26 to 50 .......... | 25 | 0) | |

On the advice of a member of the accounts department of the London Electricity Board, the value for the KVA was assumed to be equal to that of the nearest 0.5 HP below the actual figure for horsepower as stated for each case in Tables 4 to 7. Thus in case AI, where the total HP is 4.785, the KVA is 4.5 and the monthly demand charge is 4.5 x 30s. or £6.75. Column f. The running unit charge is 3d. per unit in the area where the factory is situated.

*Table 13. Quantities and Costs of Wood Fuel for Boilers*

*Table 22. Quantities of Water, Hot Water and Steam, Estimated Boiler Capacity.*

Column c. of Table 13. These items have been derived from Table 22, which contains estimates of the British Thermal Units (B Th U's)* required for heating water used in various processes and for cleaning. The boilers are assumed to be in operation for eight hours a day in order to allow for cleaning which is done when processing machines are not running.

Steam boilers are necessary in all cases where orange juice is pasteurised (cases A to D, I and II), and a steam boiler is assumed to be used in case D III the largest plant making squash from compound only. Water boilers are assumed to be used in cases A to C, III.

Rows 16 to 18 of Table 22 shows the estimated B Th U's required for each process. In the case of fruit and bottle washing machines, B Th U's are estimated by multiplying the weight in lb. of hot water required per hour by the difference between the required temperature and 60°F, which is the assumed temperature of cold water (one gallon of water weighs 10 lb). In the case of steam jacketed pans, the B Th U's are estimated by multiplying the number of lb. of steam required by 1,000.** The resulting B Th U's are added to give the total B Th U's shown in rows 19 and 21. Rosw 20 and 22 of Table 22 show the approximate capacity of the boilers. A third must be added to the estimated B Th U's required, to estimate the capacity of the steam boilers in order to allow for the fact that a larger fuel compartment is required for burning wood than for coal. The approximate rating for the water boilers used in cases A III, B III and C III were supplied by the manufacturers.

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* A B Th U is the quantity of heat required to raise the temperature of 1 lb. of water through 1°F.

**This results from the fact that 1,000 B Th U's of latent heat per lb. are required to convert water to steam.

The estimates for fuel required must also allow for the efficiency of the boilers which has been assumed to be 65 per cent. Thus, in Table 13, for case AI, the figure of 3,813,000 B Th U's per shift (c.1) is derived from the 309,800 B Th U's per hour shown in Table 22 (c.19) as follows:

$$\frac{309,800 \text{ B Th U's} \times 8 \text{ hours}}{0.65 \text{ (boiler efficiency)}} = 3,812,923 = 3,813,000 \text{ B Th U's}$$

Column d. The wood assumed to be used is a common one in the area having a calorific value of 5,500 B Th U's per lb, and weighing 26.67 lb. per cubic foot allowing for 13.5 per cent of moisture over the oven dry weight. The calorific value and the weight per cubic foot were divided into the figures in column c to estimate the quantity of wood required in cu. ft. Since the firm of the questionnaire used 128 cubic feet per production day, the figures in column d. appear to be under estimates. As the values involved are fairly low, no attempt at adjustment has been made.

*Table 14. Quantities and Costs of Water for Processing*

Column c. The method of estimating water required per shift for processing is shown in detail in rows 11 and 15 of Table 22, which is based largely on machinery makers' specifications for various processes itemised in rows 3 to 7 of Table 22. An allowance of 25 per cent on the estimated total requirements of water for squash and processing was made in rows 9 and 13 of Table 22 to cover water used for cleaning. No allowance was made for extra hot water since the major part of the cleaning work is assumed to be done during the 1.6 hours per shift when the machines are not running.

The estimated total requirements of water per shift for scale A, shown in row 10 of Table 22, ranging from 3,200 gal. to 6,500 gal. per shift are of the right order of magnitude, since the firm of the questionnaire which produced at the rate of about 460 bottles per running hour, was stated to use 5,000 gal. per shift of about six running hours. There is a dearth of relevant published information on water requirements for beverage production.

Column e. The price of 4s. per 1,000 gal. was based on a price of 3s.9d. given in a source relating to the West African country which prevailed in the area in 1961.

*Table 15. Transport for Orange Collection Squash Distribution and Collection of Empty Bottles, Annual Cost of Hired Transport.*

Empirical information on the real costs of transporting oranges from farms to the factory was limited to that in the questionnaire, which also contained a little information about the distribution of squash. British firms supplied further information on beverage distribution, and on the capacity and operating costs of transport vehicles. Using these facts in conjunction with certain assumptions, models have been constructed to show how transport costs might vary as the scale of operations increases.

Columns b. to c. of Table 15 demonstrate the demand for transport resulting from the given facts and assumptions.

Column d. The quantities of oranges to be moved are taken from Table 9, c.10 and include the 4 per cent allowance for waste. The quantities of squash are based on the daily outputs. The weight of one dozen 26.2/3rd oz. bottles of squash in a cardboard carton is about 40 lb. At 300 bottles per hour for 6.4 hours, the daily output is 160 dozen. 160 x 40 lb. = 2.86 tons.

Column e. In this column the weight of material to be moved is shown as the number of loads (or part loads) for the lorries whose number and capacity is shown in columns i. and j.

Column f. The average lengths of trips have been derived from the questionnaire, in which it was stated that a 3 ton lorry travelled 5,300 miles to collect 200 tons of oranges. This yields an average journey per ton of 26.5 miles. This average length of journey has been assumed to remain constant for each model although the quantity of oranges required doubles with each increase in the scale of operations. It can be shown that this assumption is realistic by comparing the acreage necessary to supply the oranges with the total area which might be covered to yield an average journey of 26.5 miles.

Although the yield of oranges per acre in Spain was stated(37) to range from 9.4 to 18.8, the yield in tropical areas was considered in 1960 to be about 5 tons per acre.

At a yield of 5 tons per acre the planted acreage required would range from 54 for case A to 432 to case D.

If it is assumed that each factory stands in the centre of a circle of land from which the oranges are collected, the average journey of 26.5 miles can be assumed to be equal to twice the radius of a circle whose area is half that of the whole area covered.

Let R be the radius of the larger circle

Let r be the radius of the smaller circle (= 13.25 miles)

$$\pi R^2 = 2 \pi r^2$$
$$\frac{R^2}{2} = \gamma^2$$
$$\sqrt{\tfrac{1}{2}}R = \gamma = 13.25 \text{ miles}$$
$$R = 19 \text{ miles approximately}$$

Then the area of the larger circle is $\pi\, 19^2 = 1{,}130$ sq. miles.

It can thus be assumed that the two thirds of a square mile of plantation required to supply factory D can easily lie within the radius of 19 miles.

It is assumed in that in each case the factory is at the centre of a road system on which collections are made from depots on the road side. The average distance travelled tends to be equal to the average empirical journey (26.5 miles) and the maximum distance from the factory also tends to be equal to this figure. It is assumed that there are sufficient lorries to bring in daily requirements of fruit and that each time a lorry goes out on a trip it can collect a full load from a depot, and that each lorry can make four trips per shift.

Similar facts and assumptions relate to the distribution of squash. It was stated in the questionnaire that a 3 ton lorry delivers about 200 dozen bottles (20 oz.) up to 70 miles away. Again, it was assumed that the average length of trip (there and back), and also the most distant point reached both tend to equal 70 miles. It is also assumed that lorries occupied in delivering squash bring back empties on the return journey so that they cannot be used for collecting oranges while thus occupied.

Column g. The concept of the 'vehicle day' was introduced by an accountant employed by a large British firm of soft drinks manufacturers. Each of the firms lorries is assumed to be available for a number of vehicle days which is less than the number of working days in the year by the number of days required for maintenance. In this calculation the number of vehicle days per lorry is assumed to be 210 per year; i.e. 240 minus 30 days for maintenance. The amount of work to be done by the lorries can also be expressed in vehicle days as indicated in column l.

Column h. This column shows the number of depots for oranges or bottles of squash assumed to be visited once a week in each case. At scale B, the same quantity of oranges is collected from twice the number of depots as in A. At scale C. twice as much is collected from the same number of depots as in B. At scale D. the same amount is collected from twice the number of depots. Similar principles apply to squash distribution.

Column i. This column shows the annual demand for transport expressed in vehicle days, which are the product of the number of weeks worked, the number of depots visited each week and the amount of work involved in each visit.

Columns j. and k. The models to which column j refers are of a type manufactured in Britain for export only. The one with a capacity of 3.3 tons was the smallest quoted for by a firm which both sells vehicles and operates transport undertakings in West Africa, and which gave advice on estimating transport requirements. A representative of the manufacturer of the vehicles stated that the carrying capacity can be estimated by deducting from the maximum gross weight of the vehicle, the weight of the chassis and the weight of the body.

13,640 lb. - (5,140 lb. = 1,120 lb.) = 7,380 lb. = 3.3 tons.

The capacity of the larger vehicle was estimated similarly.

Given the capacities of the two types of lorry used, the appropriate number and type for each purpose, (orange collecting and squash distribution) required in the different models were determined as follows: (a) by allowing sufficient capacity in vehicle days (210 per vehicle) to cover the requirements in vehicle days as shown in column i. and (b) by allowing sufficient capacity in tons to carry the loads shown in column d.

Within the framework outlined above surplus capacity was kept down to a minimum, and it was assumed that requirements in excess of the capacity allocated in Table 15 would be met by hiring transport.

Thus in case AI, where the plant operates for 80 shifts a year, the one lorry is available for at least 80 days a year (assuming that maintenance is done outside the operating period) and since according to column i, only 60 vehicle days are needed to collect oranges and distribute squash, it is assumed that the one vehicle is sufficient for both purposes. In case A II 120 vehicle days are required for squash distribution and 20 for orange collection. Again it is assumed that one lorry is sufficient.

In case BI, 80 vehicle days are required for distributing squash (column i. 5) so that the one lorry allocated in this case would be fully loaded. On the other hand only 40 vehicle days are required for collecting oranges. Transport is therefore assumed to be hired for this purpose. In case B III, the two lorries are occupied for only 240 vehicle days out of a total of 420, so that there is surplus capacity available for other purposes.

Cases C and D are treated similarly to case B. i.e. transport is assumed to be hired for the collection of oranges, in case I there is just enough transport for the distribution of squash, and in cases II and III there is some excess capacity.

Column l. This column shows the distances in miles covered in carrying out the various tasks.

Column m. This column shows the requirements for transport in ton miles.

Column n. The price of 8d. per ton mile was suggested by the British firm which operates transport undertakings in the country, and is also quoted in a published local source.

The totals in this column related to the cost of hiring transport for orange collection and squash distribution only. There would be an additional charge for bottle collection. The rate for return journeys is not known. However, as squash distribution and empty bottle collection are assumed to be done by the firms' own lorries, this omission is not important. It should be remembered when comparing these figures with the costs shown in Table 16, that the latter allow for empty bottle collection as well.

*Table 16. Cost of Owned Transport.*

This table, which is based on Table 15 and on information supplied by the British firm operating transport in the country is largely self-explanatory.

Total annual mileage. These items shown in rows 3, 16, 29 and 41 are derived from column l of Table 15, according to the assumptions stated above. Thus in case A I, the 7,720 miles is composed of 2,120 miles for orange collection and 5,600 miles for squash distribution. In case A II, 18,920 miles equals 2,120 miles plus 16,800 miles.

*Tables 17 to 20. Complements and Costs for Management, Supervision and Labour.*

Column e. The rates of earnings used in computing the figures in this column relate to mid - 1967, which were derived from the questionnaire are set out below.

| Type of Personnel | Earnings £ (mid 1967) | Period |
|---|---|---|
| Managerial | 119.0 | month |
| Supervisory (semi-technical) | 20.5 | month |
| Semi-skilled | 10.0 | month |
| Non-skilled | 1.2 | week |

The employers' contribution to a fund to provide benefits in case of unemployment at the rate of 3d. for each complete 5s. of wages, has been allowed for approximately by multiplying the earnings costs per shift based on the above rates of earnings by 1.05. There is no such provision for managerial staff.

Columns d, h and l. The numbers of employers in this column are taken from Tables 4 to 7, and exclude transport operatives who are dealt with in Table 16.

In cases I and II, the personnel is subdivided into permanent and temporary according to whether they are retained on the pay roll all the year round or are employed only during the orange season. Managerial, supervisory and semi skilled staff are assumed to be on the payroll permanently since they would be difficult to replace if dismissed at the end of the orange season. Non-skilled operatives and clerical staff are assumed to be employed seasonally where they are employed in connection with orange processing.

*Table 21. Floorspace for Storage and Processing; Site Area.*

This table has been explained in conjunction with Table 8 which deals with the estimated cost of factory floorspace and site area (see pages 24-25).

*Table 22. Quantities of Hot Water and Steam. Estimated Boiler Capacity.*

This table has been explained in conjunction with Table 13 which deals with quantities and costs of wood fuel for boilers (see page 27).

## Appendix I

### Additional Information

Varieties of Oranges.

Tressler and Joslyn(38) list the following more important commercial varieties of oranges:

Homosassa

Parson Brown

Hamlin

Jaffa

Pineapple

Valencia

Ruby Blood

Navel (Washington Navel; Riverside Navel; Bahia).

Of the above, the Valencia is said to grow in almost every citrus processing country in the world. An expert has stated that the best varieties for juice processing are the Valencia, Blanca (main Spanish variety), Jaffa, Hamlin and Pineapple, while the Navel is totally unsuitable because bitter elements are contained in the separate segment within the orange.

The variety of orange trees found growing in most tropical countries is frequently unknown. Any oranges which might be used for processing should be assessed for quality and local agricultural departments should be asked for advice on this problem and also on the source of suitable stock if planting is being considered.

Alternative Juice Extraction Machines for Scale D

On page 6 in Chapter 2 of this report, reference is made to a small scale automatic juice extracting machine. This machine which is made in Italy would probably prove to be economic if used at scale D.

With this machine the fruit is placed on an inclined tray either by hand or by conveyor and enters the machine in four parallel lines. The fruit is pressed automatically inside the machine, and the juice flows from the machine into a linked automatic helicoidal sifter for separation of the juice from the seeds or pulp. All essential parts are made of stainless steel except the parts which come into contact with the fruit while the juice is being extracted, which are made of nylon.

The essential details follow:

| | |
|---|---|
| Capacity of juice extractor | 13,000 fruits per hour 2.32 tons per hour (if 10 fruit weigh 4 lb.) |
| Power for juice extractor | 3.5 H.P. |
| Power for sifter | 0.5 H.P. |
| Floor space for extractor and sifter | 67 sq. ft. |
| Price of extractor and sifter f.o.b. Genoa, February 1968 | 4,090,000 lire |
| Price of above at October 1967 exchange rate £1 = 1,733 lire | £2,360 |
| Estimated price delivered at factory mid-1967 | £2,648 |

This fully automatic line would replace hand-operated equipment costing £3,252 (Table 7, i, 3, 4, 5) and 27 semi-skilled operatives. On the other hand, mechanical supervision and maintenance would have to be taken into account.

There is also a British line of automatic juice extraction machinery with a capacity of 1.25 tons of oranges per hour, which cost about £3,480 f.o.b. UK in mid-1967. In this process, which requires one semi-skilled operator and two unskilled labourers, the orange is quartered and the peel separated from the pulp with great precision. The extra cost is not justified unless it is intended to sell or utilise the peel.

A Small-scale Plate Heat Exchanger for Pasteurising Juice

At the time of going to press, a British firm announced the introduction of a plate-heat exchanger which could be used to pasteurise as little as 15 gallons of juice per hour. This process would be subject to more precise control than the steam-jacketed pan. Formerly, only models of large capacity were available. Further information can be supplied on request.

The Use of Oil or Hard Fuel instead of Wood

Since adequate supplies of wood are not available in all developing countries, the effect on costs of using oil or hard fuel instead of wood has been investigated for scale D, cases I and II.

Both capital and operating costs are affected. In the first instance for burning oil or hard fuel, a boiler having only three quarters of the capacity of a wood burning boiler is required. On the other hand, in the case of oil extra equipment and floorspace are required. Operating costs are higher in the case of oil. The operating cost for coal or coke is not dealt with in this report.

The 16 H.P. boiler assumed at scale C, cases I and II is adequate for scale D cases I and II if oil or hard fuel is burned.

The respective prices delivered at the factory of these two boilers are £1,222 and £1,471;* (see Tables 6 and 7). If hard fuel were burned there would thus be a saving in capital cost of £249.

If oil were burned, it would be necessary to have in addition a steam injector type oil burner and an oil tank on stand to allow gravity feed. Including certain other items, this would cost (at October 1967 prices) £338 f.o.b. UK or £372 delivered at factory. The total cost of the 16 H.P. oil-fired boiler would be £1,394 f.o.b. UK or £1,594 at factory, involving a net addition to equipment cost of £123, (£1,594 - £1,471). The net floor-space required would be about 50 sq. ft. instead of 25 sq. ft.

The oil requirements may be calculated from Table 13, assuming the calorific value of oil of medium viscosity to be 19,000 B Th U's per lb., its specific gravity to be 0.85 and the price per gallon to be 3s. 8d.

For case DI, the estimated annual cost of oil is £1,086 compared with £163 for wood and for case DII, the annual cost of oil is £1,533 compared with £230; (see column f. of Table 13).

*By October, 1968, the ex-factory UK prices of boilers had increased by 6 per cent compared with October 1967.

The effect of using oil on estimated total annual sales cost may be considered in relation to rows 20 and 21 of Table 7. The cost of oil per 100 dozen bottles is £1.06 in case DI and £0.50 in case DII. The effect on depreciation is of a minor order and has not been calculated.

It should be stressed that owing to scale economies, the increase in operating cost would be greater for the smaller models.

Cool Storage for Compound.

There is some difference of opinion as to whether compound requires to be kept in a cool store. The type assumed in this report contains a preservative, and cool storage is considered unnecessary if small stocks and quick turnover can be maintained.

This section contains some details on the cost of providing cool storage for compound in case the circumstance should make it necessary.

The compound is packed in 10 gallon polythene-lined metal drums, which can be stacked in three tiers. The storage room should be 6.5 feet high to allow for ease of movement. At scale A an estimated area of 110 sq. ft. with a volume of 715 cu. ft. would be required. For scale D, 813 sq. ft. and 5,280 cu. ft. are required.

In order to maintain the required temperature of around 45°F. with an external temperature of 90°F. proper insulation of the building would be required as well as air conditioning equipment. A rough estimate of the cost of insulation material and equipment would be £2 per cu. ft. for scale A and £0.75 per cu. ft. for scale D. These are f.o.b. UK prices in August, 1968. The estimated c.i.f. charge would be 15 per cent. Allowing an extra 2 per cent on the c.i.f. price for delivery to the factory, the estimated additional costs for cool storage of compound would be as follows:

| | Scale A | Scale D |
|---|---|---|
| Volume in cu. ft. | 715 | 5,280 |
| F.o.b. cost | £1,430 | £3,961 |
| C.i.f. cost | £1,644 | £4,555 |
| Cost at factory | £1,677 | £4,646 |

For the smallest store the operating costs would depend on 1½ HP for the compressor plant which runs continuously and 1½ HP for lighting and fans. The lights would not be in continuous use. The corresponding quantities for scale D are 7½ HP and 2½ HP. According to Table 4, the total power required without storage or lighting is 4.785 HP in case AII and 1.660 in case AIII, and according to Table 7, the corresponding figures are 41.375 HP in case DII and 29.250 HP in case DIII. The increase in power requirements would thus be substantial.

Cool Storage for Orange Juice

It has been stated above on page 18 that a possible alternative to using compound when oranges are not in season, would be to instal twice as much orange processing equipment, and by working double shift for two months of the orange season and single shift for the other two months, to process enough orange juice to last the bottling department all through the year.

To construct a model of this type having the output of scale C, the necessary information for doubling the orange processing capacity is given

in Table 7 for scale D. However, it would also be necessary to provide cool storage capacity for eight months supply of orange juice to be used outside the harvest season which would increase both capital and operating costs.

The juice could be stored in wax lined oak barrels containing 40 gallons. The storage chamber would again have to be insulated to maintain a suitable temperature of 45°F. The estimates for equipment given in this note are based on the assumption that a week is allowed for the juice to cool down and that the store is not opened frequently.

The price of once-used wax-lined whiskey casks fluctuates between £3 and £4 each.

Early in 1968, the price per barrel delivered on the West Coast of Africa was £3.5, which becomes £3.57 if 2 per cent is added for local transport. For scale C, 38,950 gal. of juice would be required to operate for 160 days or 8 months, so that 974 barrels would be needed initially. Assuming that the barrels are stacked in 3 tiers, the necessary area for scale C would be 1,970 sq. ft. with a volume of 12,800 cu. ft.

The storage area could be divided into compartments, using three or four machines for the whole area, which could be shut down or used for storing squash. For the above area 20 HP would be required for air conditioning equipment and 4 HP for fans and lighting. The estimated f.o.b. cost for insulating material and equipment would be £0.75 per cu. ft. The estimated cost of cool storage insulation and equipment (in addition to the basic cost of the building) plus the cost of barrels would be:

| | Scale C |
|---|---|
| Area in sq. ft. | 1,970 |
| Volume in cu. ft. | 12,800 |
| F.o.b. cost | £9,604 |
| C.i.f. cost | £11,045 |
| Cost at factory | £11,266 |
| Cost of extra floorspace* | £3,447 |
| 974 barrels at £3.57 | £3,477 |
| Net addition to capital costs | £18,190 |

According to Table 2, the total capital cost for scale CII is £74,760; the net addition to capital costs estimated above amounts to 24 per cent.

There would also be an increase in working capital owing to carrying stocks of juice for eight months.

Operating costs would have to be recalculated to take account of working double shift for two months during the orange season.

Changes in prices between mid-1967 and end 1969.

Prices of machinery and materials exported from the U.K. and used in the manufacture of orange squash have increased since mid-1967. However, the reader may adjust the prices given in the tables by means of percentages to obtain a more accurate up-to-date version of capital costs and some operating costs which will be adequate for a rough assessment of the feasibility of

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*Area of 1,970 sq. ft. at £1.75 per sq. ft.; (see Table 8).

producing squash. If, on this basis, a decision to proceed is reached, machinery makers can be asked to provide an up-to-date specification.

Since mid-1967, the UK price level of machinery other than electrical, has risen by about twenty per cent and that of transportation equipment by about eight per cent. Both these percentages refer to exports from UK. The price level on the UK home market of glass containers, including bottles, has risen by a little over two per cent while that of "other glass products (except containers)" including laboratory equipment, rose by about six per cent.

It is necessary to remember that these percentages represent average changes and the increases charged by individual firms may be higher or lower. The firm which gave prices for orange compounds said that the price of tenfold orange compound (f.o.b. UK port) has risen from 27s.6d. per gal. to 30s.6d. per gal. an increase of 11 per cent.

Liner freight rates between Britain and West Africa on machinery have increased by 21 per cent or by approximately the same rate as machinery. In order to estimate the current cost of machinery delivered at the factory in West Africa, it would consequently suffice to increase the appropriate prices in the tables by 20 per cent while allowing for devaluation of the pound sterling which took place in November 1967. Prior to that date, sterling and the West African currency were at par and since then the exchange rate has been UK £1 = West African £0.85712.

The freight rate on bottles has increased by 26 per cent and that on compound by 21 per cent. These percentages can also be used for adjusting the values of the items in question.

## Appendix II


### Acknowledgements

Besides colleagues at the Tropical Products Institute many individuals and organisations were asked to supply the information or advice on which this report is based and the help of all is gratefully acknowledged. (However, none of the models represents the entire practice of any particular firm.) There follows a list of firms and other outside organisations which gave information actually used in the report. The list is subdivided according to the main subject of information given, and in the case of manufacturers, the product or activity in which we were interested is stated in brackets below the name of the firm. Names of individuals are given if they made particularly valuable contributions.

A full list of suppliers of machinery, equipment and other requirements of the soft drinks industry is published monthly in the Soft Drinks Trade Journal.

**Machinery**

A. P. V. Exports,
(Orange juice processing plant)
Manor Royal,
Crawley,
Sussex.
Mr. T. F. S. Cooper

Brierley, Collier & Hartley Ltd.,
(Fruit processing machinery)
Bridgefield Street,
Rochdale,
Lancashire.
Mr. M. G. Cottingham.

C. P. Equipment Ltd.,
(Centrifugal pumps)
Mill Green Road,
Mitcham,
Surrey.

Fratelli Indelicato,
(Fruit processing machinery)
Via Finocchiare Aprile 110,
Giarre,
Catania,
Sicily.

George S. Clayton Ltd.,
(Engineers)
Barnaby Works,
Bourne Road,
Bexley,
Kent.
Mr. S. Barrel

George S. Clayton Ltd.,
(Fruit processing and bottling machinery)
St. Anne's Works,
St. Anne Street,
Limehouse,
London, E.14.
Mr. J. S. Clayton Marshall

Ideal Standard Ltd.,
(Water boilers)
Ideal Home,
Great Marlborough Street,
London, W.1.

J. & E. Hall Ltd.,
(Refrigerating machinery)
Dartford Iron Works,
Dartford,
Kent.
Mr. A. C. Worsfold

Morgan Fairest Ltd.,
(Bottle labelling machines)
Fairway Works,
Carlisle Street,
Sheffield, 4.

Robert Kellie & Son Ltd.,
(Fruit Processing machinery)
40 East Dock Street,
Dundee.

Walter W. Coltman & Co.
(Boilers) Ltd.,
(Steam boilers)
Great Central Road,
Loughborough.
Mr. C. E. Onions

**Prices, Costing and Taxation**

Armstrong Cork Co. Ltd.,
(Bottle closures)
Export Service Department,
Kingsbury,
London, N.W.9.

Barnet & Foster Ltd.,
(Essences and Compounds)
Queensbridge Road,
London, E.8.
Mr. R. F. Smith

Board of Inland Revenue,
Somerset House,
London, W.C.2.
Mr. S. Lonsdale

Board of Trade,
Hillgate House,
35 Old Bailey,
London, E.C.4.

The Crown Cork Co. Ltd.,
(Bottle closures)
Southall,
Middlesex.

Dagenham Motors,
(Commercial vehicles)
374 Ealing Road,
Alperton.
Mr. Effingham

Electricity Corporation of Nigeria,
York House,
99, Westminster Bridge Road,
London, S.E.1.

Forster's Glass Company Ltd.,
(Bottles and containers)
Atlas Glass Works,
P.O. Box No. 41,
St. Helens,
Lancashire.

Gallenkamp (A. G. & Co. Ltd.),
(Laboratory apparatus)
6 Christopher Street,
London, E.C.2.

Glass Manufacturer's Federation,
19 Portland Place,
London, W.1.

John Holt Ltd., (Head Office)
(Export Dealers, Transportation)
India Buildings,
Liverpool, 2.
Mr. M. A. Mair

John Holt Ltd., (Export)
(Export dealers)
4th Floor, Moor House,
London Wall,
London, E.C.2.

LEB (London Electricity Board)
46 New Broad Street,
London, E.C.2.
Mr. Roberts

The Metal Box Co.,
(Glass and plastic containers)
37, Baker Street,
London, W.1.

Ministerio de Agricultura,
Ganadera y Colonizacion,
Asesores Britanicos en
Agricultura Tropical,
La Paz,
Bolivia.
Mr. C. E. Johnson

Ministry of Trade and Industry,
Western Group of Provinces of
Nigeria,
Ibadan,
Nigeria.

Motor Transport,
(Transport periodical)
Dorset House,
Stamford Street,
London, S.E.1.

Schweppes Ltd.,
(Soft drinks manufacturers)
Research Laboratory,
Garrick Road,
London, N.W.9.
Mr. W. T. Watkins

Schweppes,
(Soft drink distributors)
Grosvenor Road,
St. Albans,
Herts.
Mr. Williams

Shell International
Petroleum Co. Ltd.,
(Fuel oil)
Shell Centre,
London, S.E.1.

United Glass Ltd.,
Kingston Road,
Staines,
Middlesex.

**Processing and quality control**

Abeokuta Industrial Institute,
(Blaize Memorial)
P.O. Box 226,
Abeokuta,
Nigeria.
Mr. S. A. Martin

Beecham Food & Drink Division,
(Soft drinks manufacturers)
Beecham House,
Great West Road,
Brentford,
Middlesex.
Dr. V. L. S. Charley

British Food Manufacturers Research
Association,
Leatherhead.
Miss H. Goodall and
Mr. J. Anderson

Food Machinery Association,
14 Suffolk Street,
London, S.W.1.

J. Mills & Sons,
Mineral Water Manufacturers,
Ossory Road,
London, S.E.1.
Mr. Mills

K. Chellaram & Sons (London) Ltd.,
(Exporters and Importers)
6 Charterhouse Buildings,
London, E.C.1.
Mr. Vaugham

Moore Bros. (Swanscombe) Ltd.,
(Mineral Water Manufacturers)
Swanscombe,
Kent.
Mr. Moore

The National Association of Soft Drinks Manufacturers Ltd.,
The Gatehouse,
2 Holly Road,
Twickenham,
Middlesex.
Mr. Penn

National College of Food Technology,
Weybridge.

T. Giusti & Son,
(Food Machinery Engineers)
210 York Way,
London, N.7.

Taylor & Co.,
Soft Drinks Manufacturers,
215A London Road,
Staines.
Mr. and Mrs. Taylor

University of Bristol,
Department of Agriculture and Horticulture,
Research Station,
Long Ashton,
Bristol.
Miss M. Leach and
Dr. A. Pollard

W. J. Bush & Co. Ltd.,
Essence Distillers,
Ashgrove,
London, E.8.
Mr. Raith

Water Pollution Research Board,
Elder Way,
London Road,
Stevenage.

1. "Fruit and Vegetable Processing Technology", by D. K. Tressler and M. A. Joslyn. (The Avi Publ. Co., Westport, Connecticut, 1961), p.142.

2. Charley, V. L. S., Intern. Bottler & Packer, 1963, 37, 92.

3. "Citrus Products: Chemical Composition and Chemical Technology", by J. B. S. Braverman (Interscience, New York, 1949), p.302.

4. "Industrial Processing of Citrus Fruit", by Z. Berk (UNIDO Food Industry Studies No. 2, United Nations, New York, 1969), pp.4-6.

5. "Modern Small Industry for Developing Countries", by E. Staley and R. Morse (McGraw Hill, New York, 1965), p.114.

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7. S.I. 1964, No. 760, Food & Drugs, Composition and Labelling; The Soft Drinks Regulations 1964 (H.M.S.O., London, 1964), p.1.

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9. "Technical Conversion Factors for Agricultural Commodities", ed. P. V. Sukhature (F.A.O., Rome, 1960).

10. "The Soft Drinks Bottler", by G. A. Beattie (Mineral Water Trade Review Co. Ltd., London, 1950), Vol. I, p.77.

11. "Preservation of Fruits and Vegetables", by G. Lal, G. S. Sidappa, and G. L. Tandon (Indian Counc. of Agr. Research, New Delhi, 1960), p.116.

12. Ref. 11, p.12.

13. "Industrial Development: A Guide for Accelerating Economic Growth", by M. D. Bryce (McGraw Hill, New York, 1960) p.127.

14. Ref. 13, p.125.

15. Ref. 11, p.20.

16. "Chemistry and Technology of Citrus, Citrus Products and Byproducts", Agric. Res. Service Agricultural Handbook No. 98 (U.S. Dep. of Agr., 1962), p.53.

17. "Beverages: Soft Drink Bottlers' Handbook", by J. Z. Ruiz (All Americas Publishers Service Inc., Chicago and Mexico DF), p.64.

18. Ref. 3, p.175.

19. "Recent Advances in Fruit Juice Production", by V. L. S. Charley and others (Tech. Comm. No. 21, Commonw. Bureau Hortic. & Plantation Crops, 1950), p.77.

20. Ref. 11, p.106.

21. Ref. 7, p.12.

22. Ref. 11, p.110.

23. "Industrialization in an Open Economy: Nigeria 1945-1966", by P. Kilby (Cambridge Univ. Press, 1969), p.99.

24. Ref. 5, p.114.

25. "Economics of Private Truck Transportation", by W. Y. Oi and A. D. Hunter Jr. (Wm. C. Brown Co. Publishers, Dubuque, Iowa, 1965), pp.130, 131.

26. Kenya Census of Industrial Production (Min. of Economic Planning & Development, 1965), p.42.

27. Industrial Survey of Nigeria, 1963 (Federal Office of Statistics, Lagos, 1966), p.13.

28. Ref. 10, p.26.

29. Ref. 4, p.57.

30. Ref. 13, p.133.

31. "Fruit and Vegetable Preservation and Canning", Small Industry Analysis & Planning Report No. 15 (Min. of Commerce & Industry, New Delhi, 1958), pp.44 and 92.

32. Ref. 13, p.136.

33. "Appraisal of Investment Projects by Discounted Cash Flow: Principles and Some Short Cut Techniques", by A. M. Alfred and J. B. Evans (Chapman & Hall, London, 2nd ed., 1965), p.2.

34. "The Jusfrute Book", by G. I. Adcock (Jusfrute Ltd., Gosford, N.S.W., 2nd ed.), p.68.

35. Ref. 10, Vol. II, p.142.

36. Ref. 34, p.133.

37. "Citrus Industry of Spain", by J. H. Burke (Foreign Agric. Report No. 56, U.S. Dep. of Agr., 1961), p.17.

38. Ref. 1, p.839.

## Table I

### Costs and Economies of Scale in the Production of Orange Squash from Natural Orange Juice and Compound

Values in Sterling: mid-1967

| | | SCALE A Throughput per running hour 50 gal. Squash 300 x 26.2/3 oz. bottles | | | SCALE B Throughput per running hour 100 gal. Squash 600 x 26.2/3 oz. bottles | | | SCALE C Throughput per running hour 200 gal. Squash 1,200 x 26.2/3 oz. bottles | | | SCALE D Throughput per running hour 400 gal. Squash 2,400 x 26.2/3 oz. bottles | | | Sources |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 80 shifts oranges I £ | 80 shifts oranges 160 shifts compound II £ | 240 shifts compound III £ | 80 shifts oranges I £ | 80 shifts oranges 160 shifts compound II £ | 240 shifts compound III £ | 80 shifts oranges I £ | 80 shifts oranges 160 shifts compound II £ | 240 shifts compound III £ | 80 shifts oranges I £ | 80 shifts oranges 160 shifts compound II £ | 240 shifts compound III £ | |
| | a | b | c | d | e | f | g | h | i | j | k | l | m | n |
| 1 | Capital Costs - Total | 22,000 | 23,000 | 18,700 | 35,800 | 40,200 | 35,600 | 66,900 | 74,800 | 67,500 | 138,000 | 150,000 | 140,000 | Sum of rows 2 to 9 |
| 2 | Buildings: orange processing) syruping and bottling) | 1,500 | 1,500 | - | 2,780 | 2,780 | - | 5,200 | 5,200 | - | 10,100 | 10,100 | - | Col. d. of Table 8 |
| 3 | Syruping and bottling | - | - | 1,000 | - | - | 2,000 | - | - | 3,600 | - | - | 6,900 | Col. d. of Table 8 |
| 4 | Machinery: orange processing) syruping and bottling) | 4,460 | 4,460 | - | 5,720 | 5,720 | - | 10,400 | 10,400 | - | 23,900 | 23,900 | - | Col. i. of Tables 4-7 |
| 5 | Syruping and bottling | - | - | 1,670 | - | - | 2,490 | - | - | 5,200 | - | - | 16,800 | Col. i. of Tables 4-7 |
| 6 | Lorries | 1,870 | 1,870 | 1,870 | 1,870 | 3,740 | 3,740 | 2,600 | 5,190 | 5,190 | 5,190 | 7,780 | 7,780 | Col. i. of Tables 4-7 |
| 7 | Stores | 4,410 | 4,850 | 4,300 | 8,310 | 8,880 | 8,230 | 16,400 | 17,500 | 16,400 | 33,400 | 35,800 | 34,400 | Col. i. of Tables 4-7 |
| 8 | Installations and Unforeseens | 2,450 | 2,540 | 1,770 | 3,740 | 4,220 | 3,290 | 6,920 | 7,650 | 6,090 | 14,500 | 15,500 | 13,200 | 20% on sum of rows 2 to 7 |
| 9 | Working Capital | 7,680 | 7,780 | 8,130 | 13,400 | 14,900 | 15,900 | 25,400 | 28,900 | 31,000 | 50,500 | 57,300 | 61,500 | 2 months cash, operating costs (row c) |
| | Annual Operating Costs | | | | | | | | | | | | | |
| | Raw Materials and Supplied | | | | | | | | | | | | | |
| 10 | Squash - Oranges | 491 | 491 | - | 982 | 982 | - | 1,960 | 1,960 | - | 3,930 | 3,930 | - | Col. f. of Table 9 |
| 11 | Other ingredients | 5,830 | 5,830 | - | 11,700 | 11,700 | - | 23,300 | 23,300 | - | 46,600 | 46,600 | - | Col. f. of Table 9 |
| 12 | Squash - using compound | - | 20,200 | 30,300 | - | 40,500 | 60,700 | - | 80,900 | 121,000 | - | 162,000 | 243,000 | Col. f. of Table 10 |
| 13 | Bottles | 474 | 1,420 | 1,420 | 947 | 2,840 | 2,840 | 1,890 | 5,680 | 5,680 | 3,790 | 11,400 | 11,400 | Col. f. of Table 11 |
| 14 | Containers, closures and labels | 1,830 | 5,480 | 5,480 | 3,660 | 11,000 | 11,000 | 7,310 | 21,900 | 21,900 | 14,600 | 43,900 | 43,900 | Col. f. of Table 11 |
| | Maintenance | | | | | | | | | | | | | |
| 15 | Buildings | 10 | 10 | 7 | 19 | 19 | 14 | 36 | 36 | 25 | 69 | 69 | 47 | Col. e. of Table 8 |
| 16 | Machinery | 891 | 1,780 | 668 | 1,140 | 2,290 | 996 | 2,070 | 4,160 | 2,080 | 4,780 | 9,570 | 6,720 | I, 20% of row 4 II and III 40% of rows 4 or 5 |
| | Power, Fuel and Water | | | | | | | | | | | | | |
| 17 | Electricity | 46 | 77 | 47 | 49 | 82 | 49 | 164 | 345 | 271 | 425 | 1,020 | 896 | Col. g. of Table 12 |
| 18 | Wood fuel for boiler | 52 | 64 | 18 | 52 | 64 | 18 | 100 | 124 | 35 | 163 | 230 | 101 | Col. f. of Table 13 |
| 19 | Water, for processing and cleaning | 50 | 82 | 48 | 58 | 107 | 73 | 60 | 117 | 85 | 87 | 193 | 159 | Col. e. of Table 14 |
| | Transportation | | | | | | | | | | | | | |
| 20 | Hired transport for oranges | - | - | - | 79 | - | - | 158 | - | - | 316 | - | - | Col. n. of Table 15 |
| 21 | Collection and distribution by owned transport | 1,060 | 1,490 | 1,450 | 1,130 | 2,980 | 2,900 | 1,540 | 4,050 | 3,950 | 3,250 | 7,050 | 6,320 | Table 16 |
| 22 | Same, net of depreciation | 594 | 868 | 826 | 664 | 1,740 | 1,650 | 891 | 2,320 | 2,220 | 1,960 | 4,450 | 3,730 | Row 21 - row 32 |
| | Manpower | | | | | | | | | | | | | |
| 23 | Labour (excluding transport) | 929 | 1,640 | 1,320 | 1,460 | 3,010 | 2,520 | 2,480 | 4,220 | 3,450 | 4,030 | 5,250 | 3,820 | Tables 17-20 |
| 24 | Management and Supervision | 1,940 | 1,940 | 1,690 | 1,940 | 1,940 | 1,690 | 2,460 | 2,460 | 1,940 | 4,410 | 4,410 | 1,940 | Tables 17-20 |
| | Miscellaneous | | | | | | | | | | | | | |
| 25 | Rent of land | 4 | 4 | 3 | 7 | 7 | 5 | 14 | 14 | 9 | 28 | 28 | 18 | Col. f. of Table 8 |
| 26 | Advertising | 829 | 2,490 | 2,490 | 1,660 | 4,980 | 4,980 | 3,320 | 9,950 | 9,950 | 6,640 | 19,900 | 19,900 | 4% on sales: row 34 |
| 27 | Interest on working capital | 307 | 622 | 651 | 536 | 1,190 | 1,288 | 1,020 | 2,310 | 2,480 | 2,020 | 4,590 | 4,920 | II and III 8% on row 9 |
| 28 | Other Costs | 1,400 | 4,240 | 4,440 | 2,440 | 8,110 | 8,670 | 4,620 | 15,800 | 16,900 | 9,190 | 31,300 | 33,500 | (10% on sum of rows (10 to 28 excluding 21 |
| 29 | Total Annual Operating Costs | 15,700 | 47,300 | 49,400 | 27,300 | 90,400 | 96,400 | 51,900 | 176,000 | 188,000 | 103,000 | 349,000 | 374,000 | Sum of rows 10 to 28 |
| | Depreciation | | | | | | | | | | | | | |
| 30 | Buildings | 75 | 75 | 50 | 139 | 139 | 99 | 260 | 260 | 180 | 504 | 504 | 345 | 5% of row 2 or 3 |
| 31 | Machinery | 446 | 446 | 167 | 572 | 572 | 249 | 1,040 | 1,040 | 520 | 2,390 | 2,390 | 1,680 | 10% of rows 4 and 5 |
| 32 | Lorries | 468 | 623 | 623 | 468 | 1,250 | 1,250 | 650 | 1,730 | 1,730 | 1,300 | 2,600 | 2,600 | 33.1/3% or 25% of row 6 |
| 33 | Total Annual Sales Costs | 16,700 | 48,400 | 50,300 | 28,500 | 92,400 | 98,000 | 53,800 | 179,000 | 191,000 | 107,000 | 354,000 | 378,000 | |
| 34 | Sales Revenue | 20,700 | 62,200 | 62,200 | 41,500 | 124,000 | 124,000 | 82,900 | 249,000 | 249,000 | 166,000 | 498,000 | 498,000 | 32.4d. per bottle |
| 35 | Net Profit(1) | 4,070 | 13,800 | 11,900 | 12,900 | 32,000 | 28,400 | 29,100 | 70,200 | 58,000 | 58,000 | 144,000 | 119,000 | row 34-row 33 |
| 36 | Gross Return on Capital per cent | 18 | 60 | 64 | 36 | 80 | 74 | 44 | 94 | 86 | 43 | 96 | 85 | row 35/row 1 x 100 |

Source:

See text pages 20-21

Footnotes

(1) It is probable that the net profit and, consequently, return on capital is over-estimated, owing to under-estimation of the costs of advertising and distribution. (See text page )

\- Nil, negligible or not applicable.

The values quoted in this table have been rounded to three significant figures.

Table 2

Capital and Operating Costs per hundred dozen bottles of orange squash

Values in sterling: mid-1967

| | | Scale A 300 bottles per running hour | | | Scale B 600 bottles per running hour | | | Scale C 1,200 bottles per running hour | | | Scale D 2,400 bottles per running hour. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 80 shifts oranges I | 80 shifts oranges 160 shifts compound II | 240 shifts compound III | 80 shifts oranges I | 80 shifts oranges 160 shifts compound II | 240 shifts compound III | 80 shifts oranges I | 80 shifts oranges 160 shifts compound II | 240 shifts compound III | 80 shifts oranges I | 80 shifts oranges 160 shifts compound II | 240 shifts compound III |
| 1 | Annual output in hundred dozen bottles | 128 | 384 | 384 | 256 | 768 | 768 | 512 | 1,540 | 1,540 | 1,020 | 3,070 | 3,070 |
| | a | £ b | £ c | £ d | £ e | £ f | £ g | £ h | £ i | £ j | £ k | £ l | £ m |
| | Capital Costs | | | | | | | | | | | | |
| 2 | Total | 22,400 | 23,000 | 18,700 | 35,800 | 40,200 | 35,600 | 66,900 | 74,800 | 67,500 | 138,000 | 150,000 | 140,000 |
| 3 | Per hundred dozen bottles | 175.0 | 59.9 | 48.8 | 140.0 | 52.4 | 46.3 | 131.0 | 48.7 | 44.0 | 134.0 | 49.0 | 45.7 |
| | Annual Operating Costs | | | | | | | | | | | | |
| | Raw Materials and Supplies | | | | | | | | | | | | |
| 4 | Total | 8,620 | 33,400 | 37,200 | 17,200 | 66,900 | 74,500 | 34,500 | 134,000 | 149,000 | 69,000 | 268,000 | 298,000 |
| 5 | Per hundred dozen bottles | 67.3 | 87.1 | 97.0 | 67.3 | 87.1 | 97.0 | 67.3 | 87.1 | 97.0 | 67.3 | 87.1 | 97.0 |
| | Maintenance | | | | | | | | | | | | |
| 6 | Total | 901 | 1,790 | 675 | 1,160 | 2,310 | 1,010 | 2,110 | 4,180 | 2,110 | 4,850 | 9,640 | 6,760 |
| 7 | Per hundred dozen bottles | 7.0 | 4.7 | 1.8 | 4.5 | 3.0 | 1.3 | 4.1 | 2.7 | 1.4 | 4.7 | 3.1 | 2.2 |
| | Power, Fuel and Water | | | | | | | | | | | | |
| 8 | Total | 148 | 223 | 113 | 159 | 253 | 140 | 324 | 586 | 391 | 675 | 1,440 | 1,160 |
| 9 | Per hundred dozen bottles | 1.2 | 0.6 | 0.3 | 0.6 | 0.3 | 0.2 | 0.6 | 0.4 | 0.3 | 0.7 | 0.5 | 0.4 |
| | Transportation | | | | | | | | | | | | |
| 10 | Total | 594 | 868 | 826 | 743 | 1,740 | 1,650 | 1,050 | 2,320 | 2,220 | 2,270 | 4,450 | 3,730 |
| 11 | Per hundred dozen bottles | 4.6 | 2.3 | 2.2 | 2.9 | 2.3 | 2.2 | 2.0 | 1.5 | 1.4 | 2.2 | 1.4 | 1.2 |
| | Manpower | | | | | | | | | | | | |
| 12 | Total | 2,870 | 3,590 | 3,010 | 3,400 | 4,960 | 4,200 | 4,940 | 6,680 | 5,400 | 8,440 | 9,650 | 5,770 |
| 13 | Per hundred dozen bottles | 22.5 | 9.3 | 7.8 | 13.3 | 6.5 | 5.5 | 9.6 | 4.3 | 3.5 | 8.2 | 3.1 | 1.9 |
| | Miscellaneous | | | | | | | | | | | | |
| 14 | Total | 2,540 | 7,360 | 7,580 | 4,640 | 14,300 | 14,900 | 8,970 | 28,000 | 29,300 | 17,900 | 55,800 | 58,400 |
| 15 | Per hundred dozen bottles | 19.8 | 19.2 | 19.7 | 18.1 | 18.6 | 19.4 | 17.5 | 18.2 | 19.1 | 17.5 | 18.2 | 19.0 |
| | Annual Operating Costs(1) | | | | | | | | | | | | |
| 16 | Total | 15,700 | 47,300 | 49,400 | 27,300 | 90,400 | 96,400 | 51,900 | 176,000 | 188,000 | 103,000 | 349,000 | 374,000 |
| 17 | Per hundred dozen bottles | 122.0 | 123.0 | 129.0 | 107.0 | 118.0 | 126.0 | 101.0 | 114.0 | 123.0 | 101.0 | 114.0 | 122.0 |
| | Depreciation | | | | | | | | | | | | |
| 18 | Total | 989 | 1,140 | 840 | 1,180 | 1,960 | 1,600 | 1,900 | 3,030 | 2,430 | 4,190 | 5,490 | 4,620 |
| 19 | Per hundred dozen bottles | 7.7 | 3.0 | 2.2 | 4.6 | 2.5 | 2.1 | 3.8 | 2.0 | 1.6 | 4.1 | 1.8 | 1.5 |
| | Annual Sales Costs(1) | | | | | | | | | | | | |
| 20 | Total | 16,700 | 48,400 | 50,300 | 28,500 | 92,400 | 98,000 | 53,800 | 179,000 | 191,000 | 107,000 | 354,000 | 378,000 |
| 21 | Per hundred dozen bottles | 130.0 | 126.0 | 131.0 | 111.0 | 120.0 | 128.0 | 105.0 | 116.0 | 124.0 | 105.0 | 115.0 | 123.0 |

Source

Table 1

Footnotes

(1) See footnote (1) of Table 1

The values quoted in this table have been rounded to three significant figures.

Table 3

The Effect of Local Taxation on Net Profits, Rate of Return and Pay-off Period

Values in Sterling: mid-1967

| | | Scale A 300 bottles per running hour | | | Scale B 600 bottles per running hour | | | Scale C 1,200 bottles per running hour | | | Scale D 2,400 bottles per running hour | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 80 shifts oranges I £ | 80 shifts oranges 160 shifts compound II £ | 240 shifts compound III £ | 80 shifts oranges I £ | 80 shifts oranges 160 shifts compound II £ | 240 shifts compound III £ | 80 shifts oranges I £ | 80 shifts oranges 160 shifts compound II £ | 240 shifts compound III £ | 80 shifts oranges I £ | 80 shifts oranges 160 shifts compound II £ | 240 shifts compound III £ |
| | a | b | c | d | e | f | g | h | i | j | k | l | m |
| 1 | Gross Profit (Row 34-29 of Table 1) | 5,060.0 | 14,900.0 | 12,800.0 | 14,100.0 | 34,000.0 | 28,000.0 | 31,100.0 | 73,200.0 | 60,400.0 | 62,800.0 | 149,000.0 | 124,000.0 |
| | Annual Allowances | | | | | | | | | | | | |
| 2 | Buildings 5.0 Per Cent on Row 2 of Table 1 | 75.2 | 75.2 | | 139.0 | 139.0 | | 260.0 | 260.0 | | 504.0 | 504.0 | |
| 3 | Plant 10 Per Cent on Rows 4, 5 and 6 of Table 1 | 632.0 | 632.0 | 354.0 | 759.0 | 946.0 | 623.0 | 1,300.0 | 1,560.0 | 1,040.0 | 2,910.0 | 3,170.0 | 2,460.0 |
| 4 | Total Annual Allowances Row 2 + 3 | 708.0 | 708.0 | 354.0 | 898.0 | 1,090.0 | 623.0 | 1,560.0 | 1,820.0 | 1,040.0 | 3,420.0 | 3,680.0 | 2,460.0 |
| 5 | Taxable Adjusted Gross Profit (Row 1-4) | 4,350.0 | 14,200.0 | 12,400.0 | 13,200.0 | 32,900.0 | 27,400.0 | 29,500.0 | 71,400.0 | 59,400.0 | 59,400.0 | 145,000.0 | 121,000.0 |
| 6 | Company Tax at 8s. in the £ (Row 5 x 4) | 1,740.0 | 5,690.0 | 4,960.0 | 5,290.0 | 13,200.0 | 11,000.0 | 11,800.0 | 28,600.0 | 23,700.0 | 23,800.0 | 58,200.0 | 48,600.0 |
| 7 | Profit After Tax (Row 1-6) | 3,320.0 | 9,240.0 | 7,800.0 | 8,830.0 | 20,800.0 | 17,100.0 | 19,300.0 | 44,700.0 | 36,700.0 | 39,100.0 | 90,900.0 | 75,300.0 |
| 8 | Net Profit After Depreciation and Tax (Row 7 - row 30, 31 and 32 of Table 1) | 2,330.0 | 8,100.0 | 6,960.0 | 7,650.0 | 18,900.0 | 15,500.0 | 17,300.0 | 41,600.0 | 34,200.0 | 34,900.0 | 85,400.0 | 70,700.0 |
| 9 | Total Capital Costs (Row 1 of Table 1) | 22,400.0 | 23,000.0 | 18,700.0 | 35,800.0 | 40,200.0 | 35,600.0 | 66,900.0 | 74,800.0 | 67,500.0 | 138,000.0 | 150,000.0 | 140,000.0 |
| 10 | Total Residual Capital(2) Costs after Allowances | 21,900.0 | 22,600.0 | 18,600.0 | 35,300.0 | 39,500.0 | 35,200.0 | 66,000.0 | 73,600.0 | 66,900.0 | 135,000.0 | 148,000.0 | 139,000.0 |
| 11 | Return on Capital (Row 8 as percentage of 10) | 10.6<br>11 | 35.9<br>36 | 37.6<br>38 | 21.7<br>22 | 47.7<br>48 | 43.9<br>44 | 26.3<br>26 | 56.6<br>57 | 51.2<br>51 | 25.7<br>26 | 57.8<br>58 | 50.9<br>51 |
| 12 | Pay-off Period (Row 10 divided by row 7) | 6.60<br>6¾ | 2.43<br>2½ | 2.37<br>2½ | 3.99<br>4 | 1.90<br>2 | 2.06<br>2 | 3.42<br>3½ | 1.65<br>1¾ | 1.82<br>2 | 3.47<br>3½ | 1.62<br>2¼ | 1.84<br>2 |

Sources

Table 1
See text pages 21-22

Footnotes

(1) This table illustrates the effect of a country's tax system on profit. The actual magnitude of gross profits and return on capital after tax are likely to be over-estimated, and pay-off periods are likely in reality to be longer. (See page 21 of text).

(2) Tax avoided as a result of initial allowances which are 10% for buildings and 15% for plant has been calculated at 8s. in the £ and deducted from total capital costs in row 9.

The values quoted in this table have been rounded to three significant figures.

## Table 4

## Scale A: Quantities and Costs of Equipment and Stores. Quantities of Power, Floorspace and Labour

Throughput per running hour

375 lb. of sorted oranges
150 lb. of juice
50 gal. of squash
300 x 26.2/3 oz. bottles

Alternative modes of operating

I 80 shifts a year using natural orange juice
II 80 shifts a year using natural orange juice and 160 shifts a year using orange compound
III 240 shifts a year using orange compound

Values in sterling: mid-1967.

| | List of Processes, Equipment and Stores | Capacity of one Unit: Maximum throughput per running hour | Utilisation factor: Per cent | Electric Motors: H.P. Per Unit | Floor Space per Unit: Square feet | Price of each Unit: f.o.b. U.K. port £ | Price of each Unit: delivered at factory (estimate) £ | Number of Units required in Section | Cost of Equipment in Section £ | Power per Section (row d. x h.) H.P. | Net Floor-space for Equipment (row e. x h.) Square feet | Labour Requirement: Management | Labour Requirement: Supervisory | Labour Requirement: Semi-Skilled | Labour Requirement: Non-Skilled | Labour Requirement: Clerical |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | a | b | c | d | e | f | g | h | i | j | k | l | m | n | o | p |
| | Processing Equipment | | | | | | | | | | | | | | | |
| | Juice Extraction | | | | | | | | | | | | | | | |
| 1. | Fruit washer | ... | ... | 0.50 | 18.80 | 810 | 903 | 1 | 903 | 0.50 | 18.80 | – | – | – | 1 | – |
| 2. | Sorting table | – | – | | 15.00 | – | ... | 1 | ... | – | 15.00 | – | – | – | 2 | – |
| 3. | Halving machine | 4,800 fruits 1,920 lb. | 20 | 0.75 | 4.17 | 292 | 330 | 1 | 330 | 0.75 | 4.17 | – | – | – | 1 | – |
| 4. | Juice extractor, double headed | 1,500 fruits 600 lb. | 62 | 0.75 | 4.81 | 233 | 259 | 1 | 259 | 0.75 | 4.81 | – | – | – | 2 | – |
| 5. | Juice separator | 120 lb. juice | 62 | 0.25 | 4.00 | 84 | 94 | 2 | 188 | 0.50 | 8.00 | – | – | – | 2 | – |
| 6. | Steam jacketed pan and pump | 50 gal.(1) | | 0.125 + 0.50 | 7.25 | 448 | 500 | 1 | 500 | 0.62 | 7.25 | – | – | 1 | – | – |
| 7. | Sub-total Juice/Extraction | – | – | | – | – | – | – | 2,180 | 3.12 | 58.00 | – | 1 | 1 | 8 | 1 |
| | Syruping and Bottling | | | | | | | | | | | | | | | |
| 8. | Cold process syrup-maker agitator, filter and pump | 50 gal.(1) | | 0.33 + 0.33 + 0.50 | 8.56 | 566 | 631 | 1 | 631 | 1.16 | 8.56 | – | –) | 1 | – | – |
| 9. | Blending vessel with stirring unit | 50 gal.(1) | | 0.125 | 4.00 | 210 | 235 | 2 | 470 | 0.25 | 8.00 | – | –) | | – | – |
| 10. | Filling machine, 6-spout | 810 bottles 135 gal. | 37 | – | 3.75 | 184 | 205 | 1 | 205 | – | 3.75 | – | – | – | 1 | – |
| 11. | Capping machine | 480 bottles | 62 | – | – | 56 | 62 | 1 | 62 | – | – | – | – | – | 1 | – |
| 12. | Labelling table | – | – | – | 15.00 | – | – | 1 | – | – | 15.00 | – | – | – | 1 | – |
| 13. | Bottle washing machine | 700 bottles | 43 | 0.25 | 8.75 | 143 | 159 | 1 | 159 | 0.25 | 8.75 | – | – | – | 8 | – |
| 14. | Sub-total, syruping and Bottling | – | – | – | – | – | – | – | 1,530 | 1.66 | 44.10 | 1 | 1 | 1 | 11 | 1 |
| | Alternative Heating Units | | | | | | | | | | | | | | | |
| 15. | Steam boiler, and feed pump | 9 H.P.(1) | – | – | 16.00 | 675 | 748 | 1 | 748 | – | 16.00 | – | – | – | 1 | – |
| 16. | or Water boiler with cylinder | 80 gal.(1) | – | – | 4.00 | 121 | 144 | 1 | 144 | – | 4.00 | – | – | – | 1 | – |
| | Equipment Totals | | | | | | | | | | | | | | | |
| 17. | All processes I and II (rows 7 + 14 + 15) | – | – | – | – | – | – | – | 4,460 | 4.78 | 118.00 | 1 | 2 | 2 | 20 | 2 |
| 18. | Syruping and bottling III (rows 14 + 16) | – | – | – | – | – | – | – | 1,670 | 1.66 | 48.10 | 1 | 1 | 1 | 12 | 1 |
| | Transport Equipment | | | | | | | | | | | | | | | |
| 19. | Lorry I | 3.3 tons(1) | – | – | – | 822 | 1,870 | 1 | 1,870 | – | – | – | – | 1 | 1 | – |
| 20. | II and III | 3.3 tons(1) | – | – | – | 822 | 1,870 | 1 | 1,870 | – | – | – | – | 1 | 1 | – |
| | Stores | | | | | | | | | | | | | | | |
| 21. | Bottles | 26.2/3 oz.(1) | – | – | – | 4.31 per gross | 8.04 per gross | 400 gross | 3,220 | – | – | – | – | – | – | – |
| 22. | Packaging, cartons | 12(1) bottles | – | – | – | – | 1.20 per dozen | 400 dozen | 480 | – | – | – | – | – | 4 | – |
| 23. | Testing equipment and materials | – | – | – | – | – | – | – | 267 | – | – | – | – | 1 | – | – |
| 24. | Spare parts I | | – | – | – | – | – | – | 445 | – | – | – | – | – | – | – |
| 25. | II | – | – | – | – | – | – | – | 890 | – | – | – | – | – | – | – |
| 26. | III | – | – | – | – | – | – | – | 334 | – | – | – | – | – | – | – |
| | Stores – Totals | | | | | | | | | | | | | | | |
| 27. | All processes I (rows 21 to 23 + 24) | – | – | – | – | – | – | – | 4,410 | – | – | – | – | 1 | 4 | – |
| 28. | All processes II (rows 21 to 23 + 25) | – | – | – | – | – | – | – | 4,850 | – | – | – | – | 1 | 4 | – |
| 29. | Syruping and bottling III (rows 21 to 23 + 26) | – | – | – | – | – | – | – | 4,300 | – | – | – | – | 1 | 4 | – |
| | Total Labour Force | | | | | | | | | | | | | | | |
| | Excluding transport | | | | | | | | | | | | | | | |
| 30. | All processes I | – | – | – | – | – | – | – | – | – | – | 1 | 2 | 3 | 24 | 2 |
| 31. | II | – | – | – | – | – | – | – | – | – | – | 1 | 2 | 3 | 24 | 2 |
| 32. | Syruping and bottling III | – | – | – | – | – | – | – | – | – | – | 1 | 1 | 2 | 16 | 1 |

Sources.
See text pages 22-24

Footnotes

(1) Capacity or size only.
– Nil, negligible or not applicable.
... Figures not available.
--- Sub-total.

The values quoted in this table have been rounded to three significant figures.

Table 5

Scale B: Quantities and Costs of Equipment and Stores. Quantities of Power, Floorspace and Labour

Throughput per running hour

750 lb. of sorted oranges
300 lb. of juice
100 gal. of squash
600 x 26.2/3 oz. bottles

Alternative modes of operating

I 80 shifts a year using natural orange juice
II 80 shifts a year using natural orange juice and 160 shifts a year using orange compound
III 240 shifts a year using orange compound

Values in sterling, mid-1967

| | List of Processes, Equipment and Stores | Capacity of one Unit Maximum throughput per running hour | Utilisation factor Per cent | Electric Motors H.P. Per Unit | Floor Space per Unit Square feet | Price of each Unit f.o.b. U.K. port £ | Price of each Unit delivered at factory (estimate) £ | Number of Units required in Section | Cost of Equipment in Section £ | Power per Section (row d. x h.) H.P. | Net Floor-space for Equipment (row e. x h.) Square feet | Labour Requirement: Management | Supervisory | Semi-Skilled | Non-Skilled | Clerical |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | a | b | c | d | e | f | g | h | i | j | k | l | m | n | o | p |
| | Processing Equipment | | | | | | | | | | | | | | | |
| | Juice Extraction | | | | | | | | | | | | | | | |
| 1. | Fruit washer | ... | ... | 0.50 | 18.80 | 810 | 903 | 1 | 903 | 0.50 | 18.80 | - | - | - | 2 | - |
| 2. | Sorting table | - | - | - - | 15.00 | - | ... | 2 | ... | - | 30.00 | - | - | - | 4 | - |
| 3. | Halving machine | 4,800 fruits 1,920 lb. | 39 | 0.75 | 4.17 | 292 | 330 | 1 | 330 | 0.75 | 4.17 | - | - | - | 1 | - |
| 4. | Juice extractor, double headed | 1,500 fruits 600 lb. | 62 | 0.75 | 4.81 | 233 | 259 | 2 | 518 | 1.50 | 9.63 | - | - | - | 4 | - |
| 5. | Juice separator | 120 lb. | 62 | 0.25 | 4.00 | 84 | 94 | 4 | 376 | 1.00 | 16.00 | - | - | - | 4 | - |
| 6. | Steam jacketed pan and pump | 50 gal.(1) | | 0.125 + 0.50 | 7.25 | 448 | 500 | 1 | 500 | 0.62 | 7.25 | - | - | 1 | - | - |
| 7. | Sub-total Juice Extraction | - | - | - | - | - | - | - | 2,630 | 4.38 | 85.80 | - | 1 | 1 | 15 | 2 |
| | Syruping and Bottling | | | | | | | | | | | | | | | |
| 8. | Cold process syrup-maker, agitator, filter and pump | 50 gal.(1) | | 0.33 + 0.33 + 0.50 | 7.25 | 566 | 631 | 1 | 631 | 1.16 | 7.25 | - | -) | 1 | 1 | - |
| 9. | Blending vessel with stirring unit | 50 gal.(1) | | 0.125 | 4.00 | 210 | 235 | 3 | 705 | 0.38 | 12.00 | - | -) | | | |
| 10. | Filling machine, 8-spout | 1,080 bottles | 55 | - | 4.50 | 227 | 253 | 1 | 253 | - | 4.50 | - | - | - | 1 | - |
| 11. | Capping machine, hand-operated, on table | 480 bottles | 62 | - | - | 56 | 62 | 2 | 124 | - | - | - | - | - | 2 | - |
| 12. | Labelling table | - | - | - | 15.00 | - | ... | 2 | ... | - | 30.00 | - | - | - | 2 | - |
| 13. | Bottle washing machine | 1,200 bottles | 50 | 0.33 | 33.00 | 567 | 632 | 1 | 632 | 0.330 | 33.00 | - | - | - | 16 | - |
| 14. | Sub-total, Syruping and Bottling | | | | | | | | 2,340 | 1.86 | 86.80 | 1 | 1 | 1 | 22 | 2 |
| | Alternative Heating Units | | | | | | | | | | | | | | | |
| 15. | Steam boiler and feed pump I and II | 9 H.P.(1) | - | - | 16.00 | 675 | 748 | 1 | 748 | - | 16.00 | - | - | - | 1 | - |
| 16. | Water boiler with cylinder III | 80 gal.(1) | - | - | 4.00 | 121 | 144 | 1 | 144 | - | 4.00 | - | - | - | 1 | - |
| | Equipment Totals | | | | | | | | | | | | | | | |
| 17. | All processes I and II (rows 7 + 14 + 15) | - | - | - | - | - | - | - | 5,720 | 6.24 | 189.00 | 1 | 2 | 2 | 38 | 4 |
| 18. | Syruping and bottling III (rows 14 + 16) | - | - | - | - | - | - | - | 2,490 | 1.88 | 90.80 | 1 | 1 | 1 | 23 | 2 |
| | Transport Equipment | | | | | | | | | | | | | | | |
| 19. | Lorry I | 3.3 tons(1) | - | - | - | 822 | 1,870 | 1 | 1,870 | - | - | - | - | 1 | 1 | - |
| 20. | II and III | 3.3 tons(1) | - | - | - | 822 | 1,870 | 2 | 3,740 | - | - | - | - | 2 | 2 | - |
| | Stores | | | | | | | | | | | | | | | |
| 21. | Bottles | 26,2/3 oz.(1) | - | - | - | 4.31 per gross | 8.04 per gross | 800 gross | 6,430 | - | - | - | - | - | 1 | - |
| 22. | Packaging, cartons | 12(1) bottles | - | - | - | - | 1.20 per dozen | 800 dozen | 960 | - | - | - | - | - | 8 | - |
| 23. | Testing equipment and materials | - | - | - | - | - | - | - | 343 | - | - | - | - | 1 | - | - |
| 24. | Spare parts I | - | - | - | - | - | - | - | 572 | - | - | - | - | - | - | - |
| 25. | II | - | - | - | - | - | - | - | 1,140 | - | - | - | - | 1 | - | - |
| 26. | III | - | - | - | - | - | - | - | 498 | - | - | - | - | 1 | - | - |
| | Stores - Totals | | | | | | | | | | | | | | | |
| 27. | All processes I (rows 21 to 23 + 24) | - | - | - | - | - | - | - | 8,310 | - | - | - | - | 1 | 9 | - |
| 28. | All processes II (rows 21 to 23 + 25) | - | - | - | - | - | - | - | 8,880 | - | - | - | - | 2 | 9 | - |
| 29. | Syruping and bottling III (rows 21 to 23 + 26) | - | - | - | - | - | - | - | 8,230 | - | - | - | - | 2 | 9 | - |
| | Total Labour Force | | | | | | | | | | | | | | | |
| | Excluding transport | | | | | | | | | | | | | | | |
| 30. | All processes I | - | - | - | - | - | - | - | - | - | - | 1 | 2 | 3 | 47 | 4 |
| 31. | II | - | - | - | - | - | - | - | - | - | - | 1 | 2 | 4 | 47 | 4 |
| 32. | Syruping and bottling III | - | - | - | - | - | - | - | - | - | - | 1 | 1 | 3 | 32 | 2 |

Sources.
See text pages 22-24

Footnotes

(1) Capacity or size only.
\- Nil, negligible or not applicable.
... Figures not available.
Sub-total or alternative total.

The values quoted in this table have been rounded to three significant figures.

Table 6

Scale C: Quantities and Costs of Equipment and Stores. Quantities of Power, Floorspace and Labour

Throughput per running hour

1,500 lb. of oranges, sorted
600 lb. of juice
200 gal. of squash
1,200 x 26.2/3 oz. bottles of squash

Alternative modes of operating

I 80 shifts a year using natural orange juice
II 80 shifts a year using natural orange juice and
160 shifts a year using orange compound
III 240 shifts a year using orange compound

Values in sterling, mid-1967

| | List of Processes, Equipment and Stores | Capacity of one Unit | Utilisation factor | Electric Motors | Floor Space per Unit | Price of each Unit | | Number of Units required in Section | Cost of Equipment in Section (row g. x h.) | Power per Section (row d. x h.) | Net Floor-space for Equipment (row e. x h.) | Labour Requirement | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Maximum throughput per running hour | Per cent | H.P. Per Unit | Square feet | f.o.b. U.K. port £ | delivered at factory (estimate) £ | | £ | H.P. | Square feet | Management | Supervisory | Semi-Skilled | Non-Skilled | Clerical |
| | a | b | c | d | e | f | g | h | i | j | k | l | m | n | o | p |
| | Processing Equipment | | | | | | | | | | | | | | | |
| | Juice Extraction | | | | | | | | | | | | | | | |
| 1. | Fruit washer | 4,000 lb. | 37 | 0.75 + 1.0 | 82.50 | 1,350 | 1,500 | 1 | 1,500 | 1.750 | 82.50 | - | - | - | 3 | - |
| 2. | Sorting table | - | - | - | 15.00 | - | ... | 4 | ... | | 60.00 | - | - | - | 8 | - |
| 3. | Halving machine | 4,800 fruits 1,920 lb. | 78 | 0.75 | 4.20 | 292 | 330 | 1 | 330 | .750 | 4.17 | - | - | - | 3 | - |
| 4. | Juice extractor double-headed | 1,500 fruits 600 lb. | 62 | 0.75 | 4.81 | 233 | 259 | 4 | 1,036 | 3.00 | 19.30 | - | - | - | 8 | - |
| 5. | Sieving machine | 1,680 lb. juice | 36 | 1.00 | 6.17 | 470 | 522 | 1 | 522 | 1.00 | 6.17 | - | - | - | 3 | - |
| 6. | Steam jacketed pan and pump | 100 gal.(1) | | 0.25 + 0.50 | 8.56 | 659 | 734 | 1 | 734 | 0.75 | 8.56 | - | - | 1 | - | - |
| 7. | Sub-total Juice Extraction | - | - | - | - | - | - | - | 4,130 | 7.25 | 181.00 | - | 2 | 1 | 25 | 4 |
| | Syruping and Bottling | | | | | | | | | | | | | | | |
| 8. | Cold process syrup-maker agitator, filter and pump | 100 gal.(1) | | 0.50 + 0.50 + 0.50 | 8.56 | 691 | 770 | 1 | 770 | 1.50 | 8.56 | - | -) | 2 | - | - |
| 9. | Blending vessel with stirring unit | 100 gal.(1) | | 0.25 | 5.44 | 265 | 295 | 3 | 885 | 0.75 | 16.30 | - | -) | | - | - |
| 10. | Filling machine, 8-spout | 1,080 bottles | 55 | - | 4.50 | 227 | 253 | 2 | 506 | - | 9.00 | - | - | - | 2 | - |
| 11. | Capping machine semi-automatic | 840 bottles | 72 | 1.0 | 6.00 | 351 | 392 | 2 | 784 | 2.00 | 12.00 | - | - | - | 2 | - |
| 12. | Labelling machine semi-automatic | 1,800 bottles | 67 | 0.75 | 9.00 | 513 | 571 | 1 | 571 | 0.75 | 9.00 | - | - | - | 1 | - |
| 13. | Bottle washing machine semi-automatic | 2,400 bottles | 50 | 3.50 | 52.20 | 1,350 | 1,500 | 1 | 1,500 | 3.50 | 52.25 | - | - | - | 16 | - |
| 14. | Sub-total, syruping and Bottling | | - | - | - | - | - | - | 5,020 | 8.500 | 107.00 | 1 | 2 | 2 | 21 | 4 |
| | Alternative Heating Units | | | | | | | | | | | | | | | |
| 15. | Steam boiler and feed pump I and II | 16 H.P.(1) | - | - | 22.60 | 1,060 | 1,220 | 1 | 1,220 | - | 22.60 | - | - | - | 1 | - |
| 16. | Water boiler with cylinder III | 100 gal.(1) | - | - | 6.00 | 156 | 182 | 1 | 182 | - | 6.00 | - | - | - | 1 | - |
| | Equipment Totals | | | | | | | | | | | | | | | |
| 17. | All processes I and II (rows 7 + 14 + 15) | - | - | - | - | - | - | - | 10,400 | 15.80 | 310.00 | 1 | 4 | 3 | 47 | 8 |
| 18. | Syruping and bottling III (rows 14 + 16) | - | - | - | - | - | - | - | 5,200 | 8.50 | 113.00 | 1 | 2 | 2 | 22 | 4 |
| | Transport Equipment | | | | | | | | | | | | | | | |
| 19. | Lorry I | 6.8 tons(1) | - | - | - | 1,170 | 2,600 | 1 | 2,600 | - | - | - | - | 1 | 1 | - |
| 20. | II and III | 6.8 tons(1) | - | - | - | 1,170 | 2,600 | 2 | 5,190 | - | - | - | - | 2 | 2 | - |
| | Stores | | | | | | | | | | | | | | | |
| 21. | Bottles | 26.2/3 f. oz.(1) | - | - | - | 4.31 per gross | 8.04 per gross | 1,600 gross | 12,900 | - | - | - | - | - | 2 | - |
| 22. | Packaging, cartons | 12 bottles(1) | - | - | - | - | 1.20 per dozen | 1,600 dozen | 1,920 | - | - | - | - | - | 16 | - |
| 23. | Testing equipment and materials | - | - | - | - | - | - | - | 622 | - | - | - | - | 1 | - | - |
| 24. | Spare parts I | - | - | - | - | - | - | - | 1,040 | - | - | - | - | 1 | - | - |
| 25. | II | - | - | - | - | - | - | - | 2,070 | - | - | - | - | 2 | - | - |
| 26. | III | - | - | - | - | - | - | - | 1,040 | - | - | - | - | 2 | - | - |
| | Stores - Totals | | | | | | | | | | | | | | | |
| 27. | All processes I (rows 21 to 23 + 24) | - | - | - | - | - | - | - | 16,400 | - | - | - | - | 2 | 18 | - |
| 28. | All processes II (rows 21 to 23 + 25) | - | - | - | - | - | - | - | 17,500 | - | - | - | - | 3 | 18 | - |
| 29. | Syruping and bottling III (rows 21 to 23 + 26) | - | - | - | - | - | - | - | 16,400 | - | - | - | - | 3 | 18 | - |
| | Total Labour Force | | | | | | | | | | | | | | | |
| | Excluding transport | | | | | | | | | | | | | | | |
| 30. | All processes I | - | - | - | - | - | - | - | - | - | - | 1 | 4 | 5 | 65 | 8 |
| 31. | II | - | - | - | - | - | - | - | - | - | - | 1 | 4 | 6 | 65 | 8 |
| 32. | Syruping and bottling III | - | - | - | - | - | - | - | - | - | - | 1 | 2 | 5 | 40 | 4 |

Sources.
See text pages 22-24

Footnotes

(1) Capacity or size only.
... Figures not available.
\- Nil, negligible or not applicable.
--- Sub-total or alternative total.

The values quoted in this table have been rounded to three significant figures.

Table 7

Scale D: Quantities and Costs of Equipment and Stores. Quantities of Power, Floorspace and Labour

Throughput per running hour

3,000 lb. of sorted oranges
1,200 lb. of juice
400 gal. of squash
2,400 x 28.2/3 oz. bottles of squash

Alternative modes of operating

I 80 shifts a year using natural orange juice
II 80 shifts a year using natural orange juice and 160 shifts a year using orange compound
III 240 shifts a year using orange compound

Values in sterling, mid-1967

| | List of Processes, Equipment and Stores | Capacity of one Unit: Maximum throughput per running hour | Utilisation factor: Per cent | Electric Motors: H.P. Per Unit | Floor Space per Unit: Square feet | Price of each Unit: f.o.b. U.K. port £ | Price of each Unit: delivered at factory (estimate) £ | Number of Units required in Section | Cost of Equipment in Section (row g. x h.) £ | Power per Section (row d. x h.) H.P. | Net Floor-space for Equipment (row e. x h.) Square feet | Labour Requirement: Management | Supervisory | Semi-Skilled | Non-Skilled | Clerical |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | a | b | c | d | e | f | g | h | i | j | k | l | m | n | n | p |
| | Processing Equipment | | | | | | | | | | | | | | | |
| | Juice Extraction | | | | | | | | | | | | | | | |
| 1. | Fruit washer | 4,000 lb. | 75 | 0.75 + 1.00 | 82.50 | 1,350 | 1,500 | 1 | 1,500 | 1.75 | 82.50 | – | – | – | 6 | – |
| 2. | Sorting table | – | – | – | 15.00 | – | ... | 8 | ... | ... | 120.00 | – | – | – | 16 | – |
| 3. | Halving machine | 4,800 fruits 1,920 lb. | 82 | 0.75 | 4.17 | 292 | 330 | 2 | 660 | 1.50 | 8.33 | – | – | – | 6 | – |
| 4. | Juice extractor, double headed | 1,500 fruits 600 lb. | 62 | 0.75 | 4.81 | 233 | 259 | 8 | 2,070 | 6.00 | 38.50 | – | – | – | 16 | – |
| 5. | Sieving machine | 1,680 lb. juice | 71 | 1.00 | 6.17 | 470 | 522 | 1 | 522 | 1.00 | 6.17 | – | – | – | 5 | – |
| 6. | Steam jacketed pan and pump | 50 gal.(1) | – | 0.125 + 0.50 | 7.25 | 448 | 500 | 3 | 1,500 | 1.88 | 21.80 | – | – | 1 | 2 | – |
| 7. | Sub-total Juice Extraction | | – | – | – | – | – | – | 6,260 | 12.10 | 277.00 | 1 | 4 | 1 | 51 | 8 |
| | Syruping and Bottling | | | | | | | | | | | | | | | |
| 8. | Cold process syrup-maker agitator, filter and pump | 100 gal.(1) | – | 0.50 + 0.50 + 0.50 | 8.56 | 691 | 770 | 3 | 2,310 | 4.50 | 25.70 | – | –) | 4 | – | – |
| 9. | Blending vessel with stirring unit | 100 gal.(1) | – | 0.25 | 5.44 | 265 | 295 | 5 | 1,480 | 1.25 | 27.20 | – | –) | | – | – |
| 10. | Filling machine, 18 head | 560 gal. | 71 | 1.00 + 1.50 | 22.00 | 3,510 | 3,910 | 1 | 3,910 | 2.50 | 22.00 | – | – | 1 | – | – |
| 11. | Capping machine fully automatic | 3,600 bottles | 67 | 1.00 | 8.00 | 1,190 | 1,300 | 1 | 1,300 | 1.00 | 8.00 | – | – | 1 | – | – |
| 12. | Labelling machine fully automatic | 4,800 bottles | 50 | 1.00 + 1.50 | 24.50 | 1,740 | 1,850 | 1 | 1,850 | 2.50 | 24.50 | – | – | 1 | – | – |
| 13. | Bottle washing machine fully automatic | 3,600 bottles | 67 | 17.50 | 50.00 | 4,800 | 5,360 | 1 | 5,360 | 17.50 | 50.00 | – | – | 1 | 7 | – |
| 14. | Sub-total, Syruping and Bottling | – | – | – | – | – | – | – | 16,200 | 29.25 | 157.00 | 1 | 2 | 8 | 7 | 8 |
| | Alternative Heating Units | | | | | | | | | | | | | | | |
| 15. | Steam boiler and feed pump I and II | 20 H.P.(1) | – | – | 25.00 | 1,270 | 1,470 | 1 | 1,470 | – | 25.00 | – | – | – | 1 | – |
| 16. | Steam boiler and feed pump III | 6 H.P.(1) | – | – | 10.60 | 560 | 590 | 1 | 590 | – | 10.60 | – | – | – | 1 | – |
| | Equipment Totals | | | | | | | | | | | | | | | |
| 17. | All processes I and II | – | – | – | – | – | – | – | 23,900 | 41.40 | 560.00 | 2 | 6 | 9 | 59 | 16 |
| 18. | Syruping and bottling III | – | – | – | – | – | – | – | 16,800 | 29.30 | 168.00 | 1 | 2 | 8 | 8 | 8 |
| | Transport Equipment | | | | | | | | | | | | | | | |
| 19. | Lorry I | 6.8 tons(1) | – | – | – | 1,170 | 2,600 | 2 | 5,190 | – | – | – | – | 2 | 2 | – |
| 20. | II and III | 6.8 tons(1) | – | – | – | 1,170 | 2,600 | 3 | 7,780 | – | – | – | – | 3 | 3 | – |
| | Stores | | | | | | | | | | | | | | | |
| 21. | Bottles | 28.2/3 fl. oz.(1) | – | – | – | 4.31 per gross | 8.04 per gross | 3,200 gross | 25,700 | – | – | – | – | – | 2 | – |
| 22. | Packaging, cartons | 12 bottles(1) | – | – | – | – | 1.20 per dozen | 3,200 dozen | 3,840 | – | – | – | – | – | 16 | – |
| 23. | Testing equipment and materials | – | – | – | – | – | – | – | 1,440 | – | – | – | – | 1 | 1 | – |
| 24. | Spare parts I | – | – | – | – | – | – | – | 2,390 | – | – | – | – | 1 | – | – |
| 25. | II | – | – | – | – | – | – | – | 4,790 | – | – | – | – | 2 | – | – |
| 26. | III | – | – | – | – | – | – | – | 3,360 | – | – | – | – | 2 | – | – |
| | Stores – Totals | | | | | | | | | | | | | | | |
| 27. | All processes (rows 21 to 23 + 24) I | – | – | – | – | – | – | – | 33,400 | – | – | – | – | 2 | 19 | – |
| 28. | All processes (rows 21 to 23 + 25) II | – | – | – | – | – | – | – | 35,800 | – | – | – | – | 3 | 19 | – |
| 29. | Syruping and bottling (rows 21 to 23 + 26) III | – | – | – | – | – | – | – | 34,400 | – | – | – | – | 3 | 19 | – |
| | Total Labour Force | | | | | | | | | | | | | | | |
| | Excluding transport | | | | | | | | | | | | | | | |
| 30. | All processes I | – | – | – | – | – | – | – | – | – | – | 2 | 6 | 11 | 78 | 16 |
| 31. | II | – | – | – | – | – | – | – | – | – | – | 2 | 6 | 12 | 78 | 16 |
| 32. | Syruping and bottling III | – | – | – | – | – | – | – | – | – | – | 1 | 2 | 11 | 27 | 8 |

Sources.
See text pages 22-24

Footnotes

(1) Capacity or size only. ... Figures not available.
– Nil, negligible or not applicable. ---- Sub-total or alternative total.
The values quoted in this table have been rounded to three significant figures.

Table 8

Factory Floorspace and Site Area. Initial Cost of Building and Annual Cost of Repairs. Annual Rent of Land

Values in Sterling: mid-1967

| | | Total Building Area sq. ft. | Total Site Area acres | Initial Cost of Buildings at £1.75 per sq. ft. Col. 6x1.75 £ | Annual Cost of Repairs at £12 per 1,000 sq. ft. Col. 6x.012 £ | Annual Cost of Rent at £100 per acre Col. cx100 £ | Estimated Costs at Local Prices(1) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Buildings | Repairs | Rent |
| | a | b | c | d | e | f | g | h | i |
| | **Scale A** | | | | | | | | |
| 1 | I Oranges | 860 | 0.039 | 1,500 | 10 | 4 | ----- | ----- | ----- |
| 2 | II Oranges and Compound | 860 | 0.039 | 1,500 | 10 | 4 | ----- | ----- | ----- |
| 3 | III Compound | 570 | 0.026 | 997 | 7 | 3 | ----- | ----- | ----- |
| | **Scale B** | | | | | | | | |
| 4 | I Oranges | 1,590 | 0.073 | 2,780 | 19 | 7 | ----- | ----- | ----- |
| 5 | II Oranges and Compound | 1,590 | 0.073 | 2,780 | 19 | 7 | ----- | ----- | ----- |
| 6 | III Compound | 1,130 | 0.052 | 1,980 | 14 | 5 | ----- | ----- | ----- |
| | **Scale C** | | | | | | | | |
| 7 | I Oranges | 2,970 | 0.136 | 5,200 | 36 | 14 | ----- | ----- | ----- |
| 8 | II Oranges and Compound | 2,970 | 0.136 | 5,200 | 36 | 14 | ----- | ----- | ----- |
| 9 | III Compound | 2,060 | 0.095 | 3,600 | 25 | 9 | ----- | ----- | ----- |
| | **Scale D** | | | | | | | | |
| 10 | I Oranges | 5,760 | 0.264 | 10,100 | 69 | 26 | ----- | ----- | ----- |
| 11 | II Oranges and Compound | 5,760 | 0.264 | 10,100 | 69 | 26 | ----- | ----- | ----- |
| 12 | III Compound | 3,940 | 0.181 | 6,900 | 47 | 18 | ----- | ----- | ----- |

Sources

Cols. b and c: Table 21. Site areas are assumed to be twice the building area. Prices are from local sources.
See text pages 24-25

Footnotes

(1) Spaces in this and some of the subsequent tables are for the reader's use.

The values quoted in this table have been rounded to three significant figures.

## Table 9

**Quantities and Costs of Materials per Shift for Squash made from Fresh Orange Juice (Scale A. 300 x 26.2/3 oz. bottles per Running Hour)**

Values in Sterling: mid-1967

| | Ingredients for Squash, 25 per cent juice 45° Brix (1) 1.5 per cent acidity | | Quantity required per shift of 6.4 running hours | Price per unit | | Cost per shift Col. $\frac{c+e}{20}$ | Estimated Local Costs | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | f.o.b. U.K. port Shillings | Delivered at factory Shillings | £ | Local price | Local cost per shift Col. cxg | Annual cost at required output(3) |
| | a | b | c | d | e | f | g | h | i |
| 1 | Juice, 10° Brix 0.8% acidity | lb. | 960.00 | - | - | - | - | - | - |
| 2 | Sugar | lb. | 1,580.00 | ... | 0.625 | 49.40 | ----- | ----- | ----- |
| 3 | Citric Acid | lb. | 49.80 | 2.33 | 3.270 | 8.15 | ----- | ----- | ----- |
| 4 | Orange Extract N.R.S. | gal. | 2.00 | 90.00 | 146.000 | 14.60 | ----- | ----- | ----- |
| 5 | Water | gal. | 122.40 | --- | 4.000 (per thousand gal.) | 0.02 | ----- | ----- | ----- |
| 6 | Orange Colour | lb. | 0.50 | 12.20 | 17.200 | 0.43 | ----- | ----- | ----- |
| 7 | Preservative, potassium metabisulphite | lb. | 2.40 | ... | 2.680 | 0.32 | ----- | ----- | ----- |
| 8 | Totals excluding orange costs | gal.<br>lb. | 320.00<br>3,840.00 | - | - | 72.80<br>----- | ----- | ----- | ----- |
| 9 | Oranges, net | lb. | 2,400.00 | - | - | | | | |
| 10 | including 4% wastage) | tons | 1.12 | - | 110.000(2) | 6.14 | ----- | ----- | ----- |
| 11 | Totals including orange costs | - | - | - | - | 79.00 | ----- | ----- | ----- |

Sources

Col. c. Ref. 11.

Cols. d and e. British manufacturers and local sources.

See text page 25

Footnotes

(1) The Brix scale denotes the percentage by weight of sugar in a solution. The 45 per cent of sugar included 2.5 per cent provided by the fresh orange juice.

(2) Price paid to growers.

(3) Col. h multiplied by numbers of shifts worked per year, multiplied by scale factor, e.g. 2 for 600 bottles per hour or 8 for 2,400 bottles per hour.

\- Nil, negligible or not applicable.

... Figures not available. --- Subtotal.

The values quoted in this table have been rounded to three significant figures.

Table 10

Quantities and Costs of Materials Per Shift for Squash made from Orange Compound.
(Scale A, 300 x 26.2/3 oz. bottles per Running Hour)

Values in Sterling: mid-1967

| | Ingredients | Units | Quantities required per shift of 6.4 running hours | Price per unit | | Cost per shift col. $\frac{cxe}{20}$ | Estimated local costs | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | f.o.b. U.K. port | delivered at factory | | Local price | Local cost per shift col. cxg | Annual cost at required output(1) |
| | | | | Shillings | Shillings | £ | | | |
| | a | b | c | d | e | f | g | h | i |
| 1 | Ten-fold orange squash compound | gal. | 32.0 | 27.5 | 45.000 | 72.10 | ----- | ----- | ----- |
| 2 | 9 per cent solution of sulphur dioxide | gal. | 1.0 | ... | 4.000 | 0.20 | ----- | ----- | ----- |
| 3 | Sugar | lb. | 1,730.0 | ... | 0.625 | 54.10 | ----- | ----- | ----- |
| 4 | Water | gal. | 179.0 | - | 4.000 | 0.04 (0.03576)(2) | | | |
| 5 | Total | gal. | 320.0 | - | - | 126.00 | ----- | ----- | ----- |

Sources

Col. c, d and e. British manufacturer of compound.

See text page 26

Footnotes

(1) Col. h. multiplied by number of shifts worked per year, multiplied by scale factor (e.g. 2 for 600 bottles per hour, 8 for 2,400 bottles per hour).
(2) Unrounded.
\- Nil, negligible or not applicable.
... Figures not available.

The values quoted in this table have been rounded to three significant figures

Table II

Quantities and Costs of Supplies per Shift. (Scale A. 300 x 26.2/3 oz. bottles per Running Hour)

Values in Sterling: mid-1967

| | Items | Description | Rate of usage | Quantity required per shift of 6.4 running hours | Price per unit | | Cost per shift | Estimated Local Costs | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | f.o.b. U.K. port Shillings | delivered at factory Shillings | £ | Local price | Local cost per shift col. dxh | Annual cost at required output(2) |
| | a | b | c | d | e | f | g | h | i | j |
| 1 | Bottles | 26.2/3 fluid oz. glass | 10 per cent loss | 192 1.1/3 gross | - | 88.80(1) per gross | 5.92 | ---- | ---- | ---- |
| 2 | Containers | cardboard cartons | 1 per 12 bottles | 160 | - | 2.00 per carton | 16.00 | ---- | ---- | ---- |
| 3 | Closures | resealable crown caps | 1 per bottle | 1,920 | 2.75 per gross | 5.95 per gross | 3.97 | ---- | ---- | ---- |
| 4 | Labels | size 3 x 4 in. | 1 per bottle | 1,920 | - | 30.00 per 1,000 | 2.88 | ---- | ---- | ---- |
| 5 | Sub-total rows 2 to 4 | - | - | - | - | - | 22.85 | ---- | ---- | ---- |

Sources

Column f. British manufacturers and local sources.

See text page 26

Footnotes

(1) The estimated total, cost per gross of bottles delivered is £8.039 (13.4d. per bottle). It is assumed that a deposit of 6d. per bottle is charged so that the replacement cost is 7.4d. per bottle or £4.440 per gross.

(2) Col. 1. multiplied by number of shifts worked per year, multiplied by scale factor, e.g. 2 for 600 bottles per hour, or 8 for 2,400 bottles per hour.

\- Nil, negligible or not applicable.

\--- Subtotal.

The values quoted in this table have been rounded to three significant figures.

## Table 12
## Quantities and Costs of Electric Power

Values in Sterling: mid 1967

| | | Number of shifts worked | Estimated Units per shift | Demand charge per month of 20 shifts | Total demand charge col. $\frac{b \times d}{20}$ | Cost at 3d. per unit col. $\frac{b \times c \times 3}{240}$ | Annual cost col. e+f | Average cost per unit col. $\frac{g \times 240}{b \times c}$ |
|---|---|---|---|---|---|---|---|---|
| | | | Kw. h. | £ | £ | £ | £ | pence |
| | a | b | c | d | e | f | g | h |
| | Scale A | | | | | | | |
| 1 | I Oranges | 80 | 19.00 | 6.75 | 27.0 | 19.0 | 46.0 | 7.27 |
| 2 | II Oranges | 80 | 19.00 | 6.75 | 27.0 | 19.0 | 46.0 | 7.27 |
| 3 | Compound | 160 | 6.59 | 2.25 | 18.0 | 13.2 | 31.2 | 7.10 |
| 4 | Total | 240 | - | - | 45.0 | 32.2 | 77.2 | 7.20(1) |
| 5 | III Compound | 240 | 6.59 | 2.25 | 27.0 | 19.8 | 46.8 | 7.10 |
| | Scale B | | | | | | | |
| 6 | I Oranges | 80 | 24.80 | 6.00 | 24.0 | 24.8 | 48.8 | 5.91 |
| 7 | II Oranges | 80 | 24.80 | 6.00 | 24.0 | 24.8 | 48.8 | 5.91 |
| 8 | Compound | 160 | 7.40 | 2.25 | 18.0 | 14.8 | 32.8 | 6.65 |
| 9 | Total | 240 | - | - | 42.0 | 39.6 | 81.6 | 6.18(1) |
| 10 | III Compound | 240 | 7.40 | 2.25 | 27.0 | 22.2 | 49.2 | 6.65 |
| | Scale C | | | | | | | |
| 11 | I Oranges | 80 | 78.60 | 21.30 | 85.2 | 78.6 | 164.0 | 6.25 |
| 12 | II Oranges | 80 | 78.60 | 21.30 | 85.2 | 78.6 | 164.0 | 6.25 |
| 13 | Compound | 160 | 42.40 | 12.00 | 96.0 | 84.9 | 181.0 | 6.39 |
| 14 | Total | 240 | - | - | 181.0 | 163.0 | 345.0 | 6.33(1) |
| 15 | III Compound | 240 | 42.40 | 12.00 | 144.0 | 127.0 | 271.0 | 6.39 |
| | Scale D | | | | | | | |
| 16 | I Oranges | 80 | 217.00 | 51.90 | 208.0 | 217.0 | 425.0 | 5.89 |
| 17 | II Oranges | 80 | 217.00 | 51.90 | 208.0 | 217.0 | 425.0 | 5.89 |
| 18 | Compound | 160 | 154.00 | 36.20 | 290.0 | 307.0 | 597.0 | 5.83 |
| 19 | Total | 240 | - | - | 498.0 | 524.0 | 1,020.0 | 5.85(1) |
| 20 | III Compound | 240 | 154.00 | 36.20 | 435.0 | 460.0 | 896.0 | 5.83 |
| | Estimated local costs | | | | | | | |

Sources
Col. c derived from col. j of Tables 2 to 5.
Monthly demand and unit charges from local source.

See text pages 26-27

Footnotes
(1) Averaged over the year.
\- Nil, negligible or not applicable.

The values quoted in this table have been rounded to three significant figures.

## Table 13

## Quantities and Costs of Wood Fuel for Boilers

Values in Sterling: mid-1967

| | | Number of shifts worked | Heat required per shift | Wood required per shift | Wood required per period | Annual cost at 6d. per cu. ft. | Estimated Local Costs | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Wood required per period if different from col. e | Local price per unit | Annual cost at required output col. e or gxh |
| | | | '000 BTUs | cu. ft. | col. bxd cu. ft. | col. $\frac{ex6}{240}$ £ | | | |
| | a | b | c | d | e | f | g | h | i |
| | Scales A and B | | | | | | | | |
| 1 | I Oranges | 80 | 3,810 | 26.0 | 2,080 | 52.0 | | | |
| 2 | II Oranges | 80 | 3,810 | 26.0 | 2,080 | - | | | |
| 3 | Compound | 160 | 443 | 3.0 | 480 | - | | | |
| 4 | Total | 240 | - | - | 2,560 | 64.0 | | | |
| 5 | III Compound | 240 | 443 | 3.0 | 720 | 18.0 | | | |
| | Scale C | | | | | | | | |
| 6 | I Oranges | 80 | 7,360 | 50.2 | 4,020 | 100.0 | | | |
| 7 | II Oranges | 80 | 7,360 | 50.2 | 4,020 | - | | | |
| 8 | Compound | 160 | 862 | 5.9 | 944 | - | | | |
| 9 | Total | 240 | - | - | 4,960 | 124.0 | | | |
| 10 | III Compound | 240 | 862 | 5.9 | 1,420 | 35.4 | | | |
| | Scale D | | | | | | | | |
| 11 | I Oranges | 80 | 12,000 | 81.5 | 6,520 | 163.0 | | | |
| 12 | II Oranges | 80 | 12,000 | 81.5 | 6,520 | - | | | |
| 13 | Compound | 160 | 2,460 | 16.8 | 2,690 | - | | | |
| 14 | Total | 240 | - | - | 9,210 | 230.0 | | | |
| 15 | III Compound | 240 | 2,460 | 16.8 | 4,030 | 101.0 | | | |

Sources

Col. c Computed from rows 19 and 21 of Table 22. Boilers are assumed to run for 8 hours per shift at an efficiency of 65 per cent.
Col. d The wood is assumed to have a calorific value of 5,500 BTU's per lb., and to weigh 26.67 lb. per cubic foot.

See text pages 27-28

Footnotes

(1) Figures in col. b were used unrounded.
\- Nil, negligible or not applicable.

The values quoted in this table have been rounded to three significant figures.

## Table 14
## Quantities and Costs of Water for Processing

Values in Sterling: mid-1967

| | | | Number of shifts worked | Water required per shift | Water required per period (stated in col. b) | Annual cost at 4s. per thousand gal. col. $\frac{dx4}{20}$ | Estimated Local Costs: Water required per period (if different from col. d) | Local price per unit | Annual cost at required output col. e or fxh |
|---|---|---|---|---|---|---|---|---|---|
| | | | | gal. | '000 gal. | £ | | | |
| | | a | b | c | d | e | f | g | h |
| | | Scale A | | | | | | | |
| 1 | I | Oranges | 80 | 3,140 | 251 | 50.2 | | | |
| 2 | II | Oranges | 80 | 3,140 | 251 | - | | | |
| 3 | | Compound | 160 | 1,000 | 161 | - | | | |
| 4 | | Total | 240 | - | 412 | 82.4 | | | |
| 5 | III | Compound | 240 | 1,000 | 241 | 48.2 | | | |
| | | Scale B | | | | | | | |
| 6 | I | Oranges | 80 | 3,650 | 292 | 58.4 | | | |
| 7 | II | Oranges | 80 | 3,650 | 292 | - | | | |
| 8 | | Compound | 160 | 1,530 | 245 | - | | | |
| 9 | | Total | 240 | - | 537 | 107.0 | | | |
| 10 | III | Compound | 240 | 1,530 | 367 | 73.4 | | | |
| | | Scale C | | | | | | | |
| 11 | I | Oranges | 80 | 3,750 | 300 | 60.0 | | | |
| 12 | II | Oranges | 80 | 3,750 | 300 | - | | | |
| 13 | | Compound | 160 | 1,780 | 285 | - | | | |
| 14 | | Total | 240 | - | 585 | 117.0 | | | |
| 15 | III | Compound | 240 | 1,780 | 427 | 85.4 | | | |
| | | Scale D | | | | | | | |
| 16 | I | Oranges | 80 | 5,440 | 435 | 87.0 | | | |
| 17 | II | Oranges | 80 | 5,440 | 435 | - | | | |
| 18 | | Compound | 160 | 3,320 | 531 | - | | | |
| 19 | | Total | 240 | - | 966 | 193.0 | | | |
| 20 | III | Compound | 240 | 3,320 | 797 | 159.0 | | | |

Sources
Cols. c and d   Table 22.
Col. d   Price from local source.
See text page 28

Footnotes
- Nil, negligible or not applicable.

The values quoted in this table have been rounded to three significant figures.

## Table 15

### Transport for Orange Collection Squash Distribution and Collection of Empty Bottles. Annual Cost of Hired Transport

Values in Sterling: mid-1967

| | | Operating periods | | Loads per shift to be moved(1) | | Average length of trip | | Number of depots visited once a week(2) | Vehicle days required per year cols. cxgxh | Lorries required (each capable of 210 vehicle days)(3) | | Distance covered per period shown in col. c.(3) col. cxfxh miles | Estimated annual cost of hired transport at 8d. per ton mile(4) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Shifts per week | Weeks per year | Tons | Number of loads | Miles | Vehicle days | | | Capacity tons | Number | | Ton-miles col. bxcxdxf/2 | Cost £ |
| | a | b | c | d | e | f | g | h | i | j | k | l | m | n |
| | Scale A, 300 bottles per running hour | | | | | | | | | | | | | |
| 1 | Orange collection I and II | 5 | 16 | 1.12 | ½ | 26.5 | ¼ | 5 | 20 | 3.3 | 1 | 2,120 | 1,190 | 39.6 |
| 2 | Squash distribution I | 5 | 16 | 2.86 | 1 | 70.0 | ½ | 5 | 40 | – | – | 5,600 | 8,010 | 266.0 |
| 3 | Squash distribution II and III | 5 | 48 | 2.86 | 1 | 70.0 | ½ | 5 | 120 | 3.3 | 1 | 16,800 | 24,000 | 801.0 |
| | Scale B, 600 bottles per running hour | | | | | | | | | | | | | |
| 4 | Orange collection I and II | 5 | 16 | 2.23 | 1 | 26.5 | ¼ | 10 | 40 | 3.3 | 1 | 4,240 | 2,360 | 78.8 |
| 5 | Squash distribution I | 5 | 16 | 5.72 | 2 | 70.0 | ½ | 10 | 180 | 3.3 | 1 | 11,200 | 16,000 | 534.0 |
| 6 | Squash distribution II and III | 5 | 48 | 5.72 | 2 | 70.0 | ½ | 10 | 240 | 3.3 | 2 | 33,600 | 48,000 | 1,600.0 |
| | Scale C, 1,200 bottles per running hour | | | | | | | | | | | | | |
| 7 | Orange collection I and II | 5 | 16 | 4.46 | 2 | 26.5 | ¼ | 10 | 40 | 3.3 | 1 | 4,240 | 4,730 | 158.0 |
| 8 | Squash distribution I | 5 | 16 | 11.40 | 2 | 70.0 | ½ | 10 | 80 | 6.8 | 1 | 11,200 | 32,000 | 1,070.0 |
| 9 | Squash distribution II and III | 5 | 48 | 11.40 | 2 | 70.0 | ½ | 10 | 240 | 6.8 | 2 | 33,600 | 96,100 | 3,200.0 |
| | Scale D, 2,400 bottles per running hour | | | | | | | | | | | | | |
| 10 | Orange collection I and II | 5 | 16 | 8.93 | 2 | 26.5 | ¼ | 20 | 80 | 3.3 | 1 | 8,480 | 9,470 | 316.0 |
| 11 | Squash distribution I | 5 | 16 | 22.90 | 4 | 70.0 | ½ | 20 | 160 | 6.8 | 2 | 22,400 | 64,100 | 2,140.0 |
| 12 | Squash distribution II and III | 5 | 48 | 22.90 | 4 | 70.0 | ½ | 20 | 480 | 6.8 | 3 | 67,200 | 192,000 | 6,410.0 |

Sources

See text pages 28–31

The values quoted in this table have been rounded to three significant figures.

Footnotes

(1) Empty bottles are assumed to be collected on return journeys.

(2) In cases B and D the same quantity of oranges is collected from twice the number of depots assumed in cases A and C respectively. In case C twice the quantity of oranges is collected from the same number of depots, as in B.

(3) There is some reason to think that the figures in these columns are under estimates. See text page 28).

(4) Transport is assumed to be hired for collection of ranges only in cases B, C and D. In all other cases, the firm's own transport is assumed to be used. Only the cost of squash distribution is estimated in col. m. The cost of bringing in empties on the return journey would be additional.

– Nil, negligible or not applicable.

Table 16

Cost of Owned Transport

Values in Sterling: mid-1967

| | Case AI | a | Case AII | b | Case AIII | c |
|---|---|---|---|---|---|---|
| 1 | 1 lorry capacity, tons | 3.3 | 1 lorry capacity, tons | 3.3 | 1 lorry capacity, tons | 3.3 |
| 2 | miles per gal. | 10 | miles per gal. | 10 | miles per gal | 10 |
| 3 | local price | £1,870(1) | local price | £1,870 | local price | £1,870 |
| 4 | Total annual mileage | 7,720 | Total annual mileage | 18,900 | Total annual mileage | 16,800 |
| | Annual costs of 1 lorry | £ | Annual costs of 1 lorry | £ | Annual costs of 1 lorry | £ |
| 5 | Depreciation, 4 year life | 468 | Depreciation, 3 year life | 623 | Depreciation, 3 year life | 623 |
| 6 | Licence and insurance | (100) | Licence and insurance | (100) | Licence and insurance | (100) |
| 7 | Wages of driver and mate | 240 | Wages of driver and mate | 240 | Wages of driver and mate | 240 |
| 8 | Annual maintenance | (50) | Annual maintenance | (50) | Annual maintenance | (50) |
| 9 | Tyres, ½ set | (50) | Tyres, 1 set | (100) | Tyres, 1 set | (100) |
| 10 | Fuel at 4s. per gal | 154 | Fuel at 4s. per gal. | 378 | Fuel at 4s. per gal. | 336 |
| 11 | Total cost. 1 lorry | 1,062 | Total cost. 1 lorry | 1,490 | Total cost. 1 lorry | 1,450 |
| 12 | Average cost per mile | 2s. 9d. | Average cost per mile | 1s. 7d. | Average cost per mile | 1s. 8¾d. |
| | Case BI | | Case BII | | Case BIII | |
| 13 | 1 lorry capacity, tons | 3.3 | 2 lorries capacity, tons | 3.3 | 2 lorries capacity, tons | 3.3 |
| 14 | miles per gal. | 10 | miles per gal. | 10 | miles per gal. | 10 |
| 15 | local price | £1,870 | local price | £1,870 | local price | £1,870 |
| 16 | Total annual mileage | 11,200 | Total annual mileage | 37,800 | Total annual mileage | 33,600 |
| | Annual cost of 1 lorry | £ | Annual cost of 1 lorry | £ | Annual cost of 1 lorry | £ |
| 17 | Depreciation, 4 year life | 468 | Depreciation, 3 year life | 623 | Depreciation, 3 year life | 623 |
| 18 | Licence and insurance | (100) | Licence and insurance | (100) | Licence and insurance | (100) |
| 19 | Wages of driver and mate | 240 | Wages of driver and mate | 240 | Wages of driver and mate | 240 |
| 20 | Annual maintenance | 50 | Annual maintenance | (50) | Annual maintenance | (50) |
| 21 | Tyres, ½ set | 50 | Tyres, 1 set | (100) | Tyres, 1 set | (100) |
| 22 | Fuel at 4s. per gal. | 224 | Fuel at 4s. per gal. | 378 | Fuel at 4s. per gal. | 336 |
| 23 | Total cost. 1 lorry | 1,132 | Total cost. 1 lorry | 1,490 | Total cost. 1 lorry | 1,450 |
| 24 | | | 2 lorries | 2,980 | 2 lorries | 2,900 |
| 25 | Average cost per mile | 2s. 4¼d. | Average cost per mile | 1s. 7d. | Average cost per mile | 1s.10¾d. |
| | Case CI | | Case CII | | Case CIII | |
| 26 | 1 lorry capacity, tons | 6.8 | 2 lorries capacity, tons | 6.8 | 2 lorries capacity, tons | 6.8 |
| 27 | miles per gal. | 8.5 | miles per gal. | 8.5 | miles per gal. | 8.5 |
| 28 | local price | £2,600 | local price | £2,600 | local price | £2,600 |
| 29 | Total annual mileage | 11,200 | Total annual mileage | 37,800 | Total annual mileage | 33,600 |
| | Annual cost of 1 lorry | £ | Annual cost of 1 lorry | £ | Annual cost of 1 lorry | £ |
| 30 | Depreciation, 4 year life | 649 | Depreciation, 3 year life | 865 | Depreciation, 3 year life | 865 |
| 31 | Licence and insurance | 200 | Licence and insurance | 200 | Licence and insurance | 200 |
| 32 | Wages of driver and mate | 240 | Wages of driver and mate | 240 | Wages of driver and mate | 240 |
| 33 | Annual maintenance | 100 | Annual maintenance | 100 | Annual maintenance | 100 |
| 34 | Tyres, ½ set | 87.5 | Tyres, 1 set | 175 | Tyres, 1 set | 175 |
| 35 | Fuel at 4s. per gal. | 264 | Fuel at 4s. per gal. | 445 | Fuel at 4s. per gal. | 395 |
| 36 | Total cost. 1 lorry | 1,540 | Total cost. 1 lorry | 2,025 | Total cost. 1 lorry | 1,980 |
| | | | 2 lorries | 4,050 | 2 lorries | 3,950 |
| 37 | Average cost per mile | 2s. 9d. | Average cost per mile | 2s. 1¾d. | Average cost per mile | 2s. 4¼d. |
| | Case DI | | Case DII | | Case DIII | |
| 38 | 2 lorries capacity, tons | 6.8 | 3 lorries capacity, tons | 6.8 | 3 lorries capacity, tons | 6.8 |
| 39 | miles per gal. | 8.5 | miles per gal. | 8.5 | miles per gal. | 8.5 |
| 40 | local price | £2,600 | local price | £2,600 | local price | £2,600 |
| 41 | Total annual mileage | 22,400 | Total annual mileage | 75,700 | Total annual mileage | 67,200 |
| | Annual cost of 1 lorry | £ | Annual cost of 1 lorry | £ | Annual cost of 1 lorry | £ |
| 42 | Depreciation, 4 year life | 649 | Depreciation, 3 year life | 865 | Depreciation, 3 year life | 865 |
| 43 | Licence and insurance | 200 | Licence and insurance | 200 | Licence and insurance | 200 |
| 44 | Wages of driver and mate | 240 | Wages of driver and mate | 240 | Wages of driver and mate | 240 |
| 45 | Annual maintenance | 100 | Annual maintanance | 100 | Annual maintenance | 100 |
| 46 | Tyres, ½ set | 175 | Tyres, 2 sets | 250 | Tyres, 1 set | 175 |
| 47 | Fuel at 4s. per gal. | 263 | Fuel at 4s. per gal. | 594 | Fuel at 4s. per gal. | 527 |
| 48 | Total cost. 1 lorry | 1,630 | Total cost. 1 lorry | 2,350 | Total cost. 1 lorry | 2,110 |
| 49 | 2 lorries | 3,250 | 3 lorries | 7,050 | 3 lorries | 6,320 |
| 50 | Average cost per mile | 2s.10¾d. | Average cost per mile | 1s.10¼d. | Average cost per mile | 1s.10½d. |

Sources

Suppliers of lorries.

Mileages from col. 1 of Table 15.

See text page 31

(1) Local prices of lorries include the cost of wooden bodies.

( ) estimate.

The values quoted in this table have been rounded to three significant figures.

## Table 17

### Scale A. Complements and Costs for Management, Supervision and Labour

Values in Sterling: mid-1967

| | Type of Employee | Status | Costs per shift, including social security payments | I 80 Shifts: oranges | | | | II 80 Shifts: oranges 160 Shifts: compound | | | | III 240 Shifts: compound | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Employees of each type and status | Shifts paid for per year | Cost per shift col. cxd/20 | Cost per year(1) col. exf | Employees of each type and status | Shifts paid for per year | Cost per shift col. cxh/20 | Cost per year(1) col. ixj | Employees of each type and status | Shifts paid for per year | Cost per shift col. cxl/20 | Cost per year(1) col. mxn |
| | | | Shillings | | | £ | £ | | | £ | £ | | | £ | £ |
| | a | b | c | d | e | f | g | h | i | j | k | l | m | n | o |
| 1 | Managerial | permanent | 119.00 | 1 | 240 | 5.95 | 1,428.0 | 1 | 240 | 5.95 | 1,430.0 | 1 | 240 | 5.95 | 1,430 |
| 2 | Supervisory | permanent | 21.50 | 2 | 240 | 2.15 | 517.0 | 2 | 240 | 2.15 | 517.0 | 1 | 240 | 1.07 | 258 |
| 3 | Subtotal | permanent | - | - | - | 8.10 | 1,945.0 | - | - | 8.10 | 1,940.0 | - | - | 7.02 | 1,690 |
| 4 | Semi-skilled | permanent | 10.50 | 3 | 240 | 1.58 | 378.0 | 3 | 240 | 1.58 | 378.0 | 2 | 240 | 1.05 | 252 |
| 5 | | temporary | 10.50 | - | - | - | - | - | - | - | - | - | - | - | - |
| 6 | Non-skilled | permanent | 5.04 | - | - | - | - | 1.6 | 240 | 4.03 | 968.0 | 16 | 240 | 4.03 | 968 |
| 7 | | temporary | 5.04 | 24 | 80 | 6.05 | 484.0 | 8 | 80 | 2.02 | 161.0 | - | - | | |
| 8 | Clerical | permanent | 8.40 | - | - | - | - | 1 | 240 | 0.42 | 101.0 | 1 | 240 | 0.42 | 101 |
| 9 | | temporary | 8.40 | 2 | 80 | 0.84 | 67.2 | 1 | 80 | 0.42 | 33.6 | - | - | - | - |
| 10 | Subtotal | permanent and temporary | - | - | - | 8.47 | 929.0 | - | - | 8.47 | 1,641.0 | - | - | 5.50 | 1,320 |

Sources

<u>Columns d, h and l.</u> Tables 4 to 7.
<u>Columns f, j and n.</u> Questionnaire.
See text page 31 and 32

Footnotes

(1) Annual costs are calculated from unrounded figures.
\- Nil, negligible or not applicable.
The values quoted in this table have been rounded to three significant figures.

## Table 18

### Scale B. Complements and Costs for Management, Supervision and Labour

Values in Sterling: mid-1967

| | Type of Employee | Status | Costs per shift, including social security payments | Scale B. 600 bottles per running hour | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | I 80 Shifts: oranges | | | | II 80 Shifts: oranges 160 Shifts: compound | | | | III 240 Shifts: compound | | | |
| | | | | Employees of each type and status | Shifts paid for per year | Cost per shift col. cxd/20 | Cost per year(1) col. exf | Employees of each type and status | Shifts paid for per year | Cost per shift col. cxh/20 | Cost per year(1) col. ixj | Employees of each type and status | Shifts paid for per year | Cost per shift col. cxl/20 | Cost per year(1) col. mxn |
| | | | Shillings | | | £ | £ | | | £ | £ | | | £ | £ |
| | a | b | c | d | e | f | g | h | i | j | k | l | m | n | o |
| 1 | Managerial | permanent | 119.00 | 1 | 240 | 5.95 | 1,430 | 1 | 240 | 5.95 | 1,430 | 1 | 240 | 5.95 | 1,430 |
| 2 | Supervisory | permanent | 21.50 | 2 | 240 | 2.15 | 517 | 2 | 240 | 2.15 | 517 | 1 | 240 | 1.07 | 258 |
| 3 | Subtotal | permanent | - | - | - | 8.10 | 1,940 | - | - | 8.10 | 1,940 | - | - | 7.02 | 1,690 |
| 4 | Semi-skilled | permanent | 10.50 | 3 | 240 | 1.58 | 378 | 4 | 240 | 2.10 | 504.0 | 3 | 240 | 1.58 | 378 |
| 5 | | temporary | 10.50 | - | - | - | - | - | - | - | - | - | - | - | - |
| 6 | Non-skilled | permanent | 5.04 | - | - | - | - | 32 | 240 | 8.06 | 1,935.0 | 32 | 240 | 8.06 | 1,940 |
| 7 | | temporary | 5.04 | 47 | 80 | 11.80 | 948 | 15 | 80 | 3.78 | 302.0 | - | - | - | - |
| 8 | Clerical | permanent | 8.40 | - | - | - | - | 2 | 240 | 0.84 | 202.0 | 2 | 240 | 0.84 | 202 |
| 9 | | temporary | 8.40 | 4 | 80 | 1.68 | 134 | 2 | 80 | 0.84 | 67.2 | - | - | - | - |
| 10 | Subtotal | permanent and temporary | - | - | - | 15.10 | 1,460 | - | - | 15.60 | 3,010.0 | - | - | 10.50 | 2,520 |

Sources

Columns d, h and l. Tables 4 to 7.

Columns f, j and n. Questionnaire.

See text page 31-32

Footnotes

(1) Annual costs are calculated from unrounded figures.

\- Nil, negligible or not applicable.

The values quoted in this table have been rounded to three significant figures.

Table 19

Scale C. Complements and Costs for Management, Supervision and Labour

Values in Sterling: mid-1967

| | Type of Employee | Status | Costs per shift, including social security payments | Scale C. 1,200 bottles per running hour | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | I 80 Shifts: oranges | | | | II 80 Shifts: oranges 160 Shifts: compound | | | | III 240 Shifts: compound | | | |
| | | | | Employees of each type and status | Shifts paid for per year | Cost per shift col. cxd/20 | Cost per year(1) col. exf | Employees of each type and status | Shifts paid for per year | Cost per shift col. cxh/20 | Cost per year(1) col. ixj | Employees of each type and status | Shifts paid for per year | Cost per shift col. cxl/20 | Cost per year(1) col. mxn |
| | | | Shillings | | | £ | £ | | | £ | £ | | | £ | £ |
| | a | b | c | d | e | f | g | h | i | j | k | l | m | n | o |
| 1 | Managerial | permanent | 119.00 | 1 | 240 | 5.95 | 1,430 | 1 | 240 | 5.95 | 1,430 | 1 | 240 | 5.95 | 1,430 |
| 2 | Supervisory | permanent | 21.50 | 4 | 240 | 4.30 | 1,030 | 4 | 240 | 4.30 | 1,030 | 2 | 240 | 2.15 | 517 |
| 3 | Subtotal | permanent | - | - | - | 10.20 | 2,460 | - | - | 10.20 | 2,460 | - | - | 8.10 | 1,940 |
| 4 | Semi-skilled | permanent | 10.50 | 5 | 240 | 2.63 | 631 | 6 | 240 | 3.15 | 756 | 5 | 240 | 2.63 | 631 |
| 5 | | temporary | 10.50 | - | - | | | - | - | | | - | - | | |
| 6 | Non-skilled | permanent | 5.04 | - | | | | 40 | 240 | 10.10 | 2,420 | 40 | 240 | 10.10 | 2,420 |
| 7 | | temporary | 5.04 | 65 | 80 | 16.40 | 1,310 | 25 | 80 | 6.30 | 504 | | | | |
| 8 | Clerical | permanent | 8.40 | 4 | 240 | 1.68 | 403 | 4 | 240 | 1.68 | 403 | 4 | 240 | 1.68 | 403 |
| 9 | | temporary | 8.40 | 4 | 80 | 1.68 | 134 | 4 | 80 | 1.68 | 134 | - | - | | |
| 10 | Subtotal | permanent and temporary | - | - | - | 22.40 | 2,480 | - | - | 22.90 | 4,220 | - | - | 14.40 | 3,450 |

Sources

Columns d, h and l. Tables 4 to 7.

Columns f, j and n. Questionnaire.

See text page 31-32

Footnotes

(1) Annual costs are calculated from unrounded figures.

\- Nil, negligible or not applicable.

The values quoted in this table have been rounded to three significant figures.

## Table 20

## Scale D. Complements and Costs for Management, Supervision and Labour

Values in Sterling: mid-1967

| | Type of Employee | Status | Costs per shift, including social security payments (Shillings) | I 80 Shifts: oranges — Employees of each type and status | I — Shifts paid for per year | I — Cost per shift col. cxd/20 (£) | I — Cost per year (1) col. exf (£) | II 80 Shifts: oranges, 160 Shifts: compound — Employees of each type and status | II — Shifts paid for per year | II — Cost per shift col. cxh/20 | II — Cost per year(1) col. ixj | III 240 Shifts: compound — Employees of each type and status | III — Shifts paid for per year | III — Cost per shift col. cxl/20 | III — Cost per year(1) col. mxn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | a | b | c | d | e | f | g | h | i | j | k | l | m | n | o |
| 1 | Managerial | permanent | 119.00 | 2 | 240 | 11.90 | 2,860 | 2 | 240 | 11.90 | 2,860 | 1 | 240 | 5.95 | 1,428 |
| 2 | Supervisory | permanent | 21.50 | 6 | 240 | 6.46 | 1,550 | 6 | 240 | 6.46 | 1,550 | 2 | 240 | 2.15 | 517 |
| 3 | Subtotal | permanent | - | - | - | 18.36 | 4,410 | - | - | 18.40 | 4,410 | - | - | 8.10 | 1,940 |
| 4 | Semi-skilled | permanent | 10.50 | 11 | 240 | 5.78 | 1,390 | 12 | 240 | 6.30 | 1,510 | 11 | 240 | 5.78 | 1,390 |
| 5 | | temporary | 10.50 | - | - | | | - | - | | | - | - | | |
| 6 | Non-skilled | permanent | 5.04 | - | | | | 27 | 240 | 6.80 | 1,630 | 27 | 240 | 6.80 | 1,630 |
| 7 | | temporary | 5.04 | 78 | 80 | 19.66 | 1,570 | 51 | 80 | 12.90 | 1,030 | - | - | | |
| 8 | Clerical | permanent | 8.40 | 8 | 240 | 3.36 | 806 | 8 | 240 | 3.36 | 806 | 8 | 240 | 3.36 | 806 |
| 9 | | temporary | 8.40 | 8 | 80 | 3.36 | 269 | 8 | 80 | 3.36 | 269 | - | - | | |
| 10 | Subtotal | permanent and temporary | - | - | - | 32.16 | 4,030 | - | - | 32.70 | 5,250 | - | - | 15.90 | 3,820 |

Sources

Columns d, h and l. Tables 4 to 7.

Columns f, j and n. Questionnaire.

See next page 31-32

Footnotes

(1) Annual costs are calculated from unrounded figures.

\- Nil, negligible or not applicable.

The values quoted in this table have been rounded to three significant figures.

## Table 21

### Floorspace for Storage and Processing, Site Area

| | Description of area | Units | Scale A 300 bottles per running hour | | Scale B 600 bottles per running hour | | Scale C 1,200 bottles per running hour | | Scale D 2,400 bottles per running hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | I and II | III | I and II | III | I and II | III | I and II | III |
| | a | b | c | d | e | f | g | h | i | j |
| 1 | Fruit store | sq. ft. | 80 | - | 160 | - | 320 | - | 640 | - |
| 2 | Juice extraction and bottling | sq. ft. | 350 | - | 570 | - | 930 | - | 1,680 | - |
| 3 | Bottling only | sq. ft. | - | 140 | - | 270 | - | 340 | - | 500 |
| 4 | Empty bottle store | sq. ft. | 230 | 230 | 460 | 460 | 920 | 920 | 1,840 | 1,840 |
| 5 | Full bottle store | sq. ft. | 200 | 200 | 400 | 400 | 800 | 800 | 1,600 | 1,600 |
| 6 | Total building area | sq. ft. | 860 | 570 | 1,590 | 1,130 | 2,970 | 2,060 | 5,760 | 3,940 |
| 7 | Total site area (row 6 x 2) | sq. ft. | 1,720 | 1,140 | 3,180 | 2,260 | 5,940 | 4,120 | 11,520 | 7,880 |
| 8 | Total site area | acres | 0.039 | 0.026 | 0.073 | 0.052 | 0.136 | 0.095 | 0.264 | 0.181 |

Sources

Rows 2 and 3. Derived by multiplying net floorspace. Totals from Tables 4-7 by 3 and rounding off.

Other rows. Sources are given in text.

See text pages 24-25.

Footnotes

- Nil, negligible or not applicable.

--- Subtotal

The values quoted in this table have been rounded to three significant figures.

Table 22

Quantities of Water, Hot Water and Steam. Estimated Boiler Capacity

| | Purpose for which water is required | Period of reference | Scale A 300 bottles per running hour | | Scale B 600 bottles per running hour | | Scale C 1,200 bottles per running hour | | Scale D 2,400 bottles per running hour | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | gal. | temperature °F. | gal. | temperature °F. | gal. | temperature °F. | gal. | temperature °F. |
| | a | b | c | d | e | f | g | h | i | j |
| 1 | Squash made from oranges | 1 hour | 20 | 60 | 40 | 60 | 80 | 60 | 160 | 60 |
| 2 | Squash made from compound | 1 hour | 28 | 60 | 56 | 60 | 112 | 60 | 224 | 60 |
| 3 | Fruit washer, hot water | 1 hour | 100 | 160 | 100 | 160 | 25 | - | 25 | - |
| 4 | Fruit washer, cold water | 1 hour | 150 | 60 | 150 | 60 | (250 lb. steam)<br>200 | 60 | (250 lb. steam)<br>200 | 60 |
| 5 | Steam jacketed pans | 1 hour | 18 | - | 18 | - | 28 | - | 53 | - |
| 6 | Bottle washer, hot water | 1 hour | (174 lb. steam)<br>80 | 105 | (174 lb. steam)<br>80 | 105 | (278 lb. steam)<br>100 | 130 | (521 lb. steam)<br>20 | - |
| 7 | Bottle washer, cold water | 1 hour | 40 | 60 | 80-100 | 60 | 100 | 60 | 350 | 60 |
| | Total water required per hour a shift | | | | | | | | | |
| 8 | All processes, I (row 1 + 3 + 4 + 5 + 6 + 7) | 1 hour | 408 | - | 488 | - | 533 | - | 808 | - |
| 9 | Cleaning allowance (row 8 x 1.25) | 1 hour | 510 | - | 610 | - | 666 | - | 1,010 | - |
| 10 | Requirements per shift (row 9 x 6.4) | 6.4 hours | 3,260 | - | 3,900 | - | 4,260 | - | 6,460 | - |
| 11 | Same, less water used in squash (row 10 - [row 1 x 6.4]) | 6.4 hours | 3,140 | - | 3,650 | - | 3,750 | - | 5,440 | - |
| 12 | Bottling only III (row 2 + 6 + 7) | 1 hour | 148 | - | 236 | - | 312 | - | 594 | - |
| 13 | Cleaning allowance (row 12 x 1.25) | 1 hour | 185 | - | 295 | - | 390 | - | 742 | - |
| 14 | Requirements per shift (row 13 x 6.4) | 6.4 hours | 1,180 | - | 1,890 | - | 2,500 | - | 4,750 | - |
| 15 | Same, less water used in squash (row 14 - [row 2 x 6.4]) | 6.4 hours | 1,000 | - | 1,530 | - | 1,980 | - | 3,320 | - |
| | Estimated BTU's required | | B Th U's | | B Th U's | | B Th U's | | B Th U's | |
| 16 | Fruit washer | 1 hour | 100,000 | - | 100,000 | - | 250,000 | - | 250,000 | - |
| 17 | Steam jacketed pan | 1 hour | 174,000 | - | 174,000 | - | 278,000 | - | 521,000 | - |
| 18 | Bottle washer | 1 hour | 36,000 | - | 36,000 | - | 70,000 | - | 200,000 | - |
| | Total BTU's required | | | | | | | | | |
| 19 | Including juice processing, I and II (row 22 + 23 + 24) (16 + 17 + 18) | 1 hour | 310,000 | - | 310,000 | - | 598,000 | - | 971,000 | - |
| 20 | Approximate boiler capacity(1) (row 19 x 1.1/3) | 1 hour | 413,000 | - | 413,000 | - | 798,000 | - | 1,300,000 | - |
| 21 | Bottling only, III (row 18) | 1 hour | 36,000 | - | 36,000 | - | 70,000 | - | 200,000 | - |
| 22 | Approximate boiler capacity (row 21 x 1.1/3) | 1 hour | 93,000(2) | - | 93,000(2) | - | 141,000(2) | - | 267,000 | - |

Sources

Rows 1 and 2. Computed from Tables 4 to 7.

Rows 3, 4 and 7. Given by machinery makers.

Row 5. Amount of water converted to steam required to produce B Th U's shown in row 17.

Rows 16 to 18. Computed by multiplying the weight in lb. of water required per hour by the difference between the required temperature and 60°F. or by multiplying the number of lb. of steam required by 1,000 to yield B Th U's.

Row 22. Figures in cols. c, e and g are catalogue ratings for water boilers of appropriate capacity.
See text pages 27-28

Footnotes

(1) One third must be added to the estimated B Th U's required to allow for the fact that a larger fuel compartment is required for wood than for coal.

(2) See source note on row 22.

\- Nil, negligible or not applicable.

The values quoted in this table have been rounded to three significant figures.

CPTRI, Experiment Station
Gole Bungalow, Chhindwara Road
Nagpur-L